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CANDLE FEET.

We especially ask the attention of our readers to the communicated article in this number.

It contains food for reflection. When we published Mr. Lamson's tables in the proceedings of the last meeting of the New England Association, we felt that there was great value in the method of stating the results of his experiments. A carefully tabulated statement of a series of results is always valuable for it almost enforces comparison, and is almost sure to lead to deductions that prove of value.

In Mr. Farmer's article in another column he proposes for adoption a new term, which seems so simple that it cannot be misunderstood. This term is CANDLE FEET, by which it is meant to express the *light-giving power* of one pound of coal.

We often hear of the yield per pound of coal, and the illuminating power of gas. This term, as proposed by Mr. Farmer, expresses the product of the two, and, if adopted, would give a concise expression for what is now only expressed by a long and roundabout phraseology. With reference to the other points in the article we hope that they will be not only read but discussed through our colums. While we would not for a moment discourage any one, still, from all the information that we can gather, gas makers are not so very much driven just now that they could not find a little spare time for putting down some of their views on paper.

We doubt not many are engaged in preparing themselves for the discussion of the various subjects marked out for the next meeting of the American Gas Light Assciation, but in the mean time an idea set rolling may gather force by discussion, and new ideas may be evolved that will prove of service in the end.

ELEMENTS OF PHYSICAL MANIPULATION.

By Prof. E. C. PICKERING.

The Riverside Press, of Cambridge, are about issuing the Second Volume of this most excellent work. Prof. Pickering has furnished a much needed handbook in this publication.

The scope of the book has been very much enlarged from its original design, and "aims to describe the principal methods of experiment with which every physicist should be familiar." In describing these methods the author divides each into two parts—first giving a careful description of the apparatus necessary, and secondly the details of using the same. This Second Volume treats of Electricity, Heat, Mechanical Engineering, Meteorology, Practical Astronomy, Lantern Projections, etc., with three appendices. One of which consists of 20 very valuable tables, which, besides the usual tables of squares, logarithms, signs, etc., comprise tables of useful constants, properties of metals, liquids, gases and vapors, and much other valuable information which is seldom found in so concise and compact a form.

To the amateur in Physics the book will be a never-ending source of occupation, while to the student and to the engineer, the instructor and the practical man, it will be invaluable. Among other things, it gives a list of the works and authors considered to be the best standard authority on the various subjects to which the book relates. Many are the times when one is following up some line of investigation, that a list of books of authority that might be consulted bearing upon the subject in hand, would be of great value, both in saving of time and in giving confidence in the results obtained. The whole style of the work is simple and well adapted to the purpose for which it was designed. It is printed on excellent paper with good clear type, and has illustrations when necessary. This part of the work reflects much credit upon the Messrs. Hurd and Houghton, Publishers.

To all interested in experimental work of any kind, these two volumes cannot fail to be of service.

RESULTS OBTAINED AT THE DRESDEN GAS WORKS.

From the *Journal fur Gasbeleuchtung* we take the following figures as to the working of the Dresden Gas Works (2 works):

Gas made, old works	5,071,120	cu. meters.
" " new "	4,279,060	" "
		" "
" " total	9,350,180	" "
Gas sold consumers	6,750,478	cu. meters.
" Public lamps	1,853,829	" "
" Used in works	48,289	" "
" unaccounted for	697,584	"
No. private burners	93,083	
" Street lamps	4,326	
" Meters	7,592	
Largest daily make, Dec. 18th.	48,060	cu. meters.
Number of benches	50	
" retorts	325	
Total No. of charges	319,403	

34·12 lbs. coke used for each 100 lbs. coal carbonized, 58·3 pr. ct. of coke made was used for fires.

SKETCH OF HARRISON McKINSTRY.

Harrison McKinstry, whose death occurred at Royer's Ford, Pa., on May 20th, 1876, by being crushed between two passing trains while attempting to get on to one of them, was well known throughout the country from his connection with the erection of gas works.

He was by trade a blacksmith, and entered the works of the senior member of the firm of Jesse W. Starr & Son, at Camden, N. J., in 1844, continuing with this concern, with the exception of two years spent at farming, until the time of his death—most of these years being spent in superintending the erection of the large number of gas holders and apparatus for gas works, which this firm has constructed in various parts of the United States.

He probably possessed as extensive an experience and as large a practical knowledge of the manufacture and putting together of gas apparatus as any other man in the country.

He was remarkable for his native ingenuity in times of emergency, requiring prompt and decided action, as well as for his excellent judgment and extreme caution.

He was honest and conscientious in the discharge of all of his duties; possessed of unimpeachable integrity; and had a suavity of manner which made his ecmpanionship agreeable and desirable to all who knew him.

His death was particularly sad, happening as it did as he was about returning home in response to a telegram to hasten to the bedside of his wife then dangerously ill.

His wife survived him but 48 hours. He was 62 years of age.

He leaves two sons and two daughters to mourn his loss, beside very many friends, none of whhm more sincerely regret his melancholy demise than the firm he represented so faithfully and so well through so long a period of years.

The Amount of Light Obtained from Coal.

111 Broadway, New York, April 10, 1876.

Mr. Editor: I beg to point out a few important facts relating to experiments made by Mr. Lamson, at the Boston Gas Works, February 18th and 23d, 1876, which I hope will convince every engineer that a much larger amount of light may be obtained from one pound of Penn coal than is generally extracted.

For the purpose of making the said facts as clear as possible, I will first introduce to your notice, a new and much more simple method for comparing one test with another, than by the formula for sperm equivalent, or any other.

I merely multiply the candle power by the yield of gas per pound of coal, and call the product—*candle feet*. This formula brings the yield and candle power together under one simple term, which can be easily understood and applied.

By this formula we can easily compare one gas with another, as, for example—

If one pound of Penn coal will yield 4.25 cubic feet of 15.75 candle gas, and one pound of Despard coal will yield 4·25 cubic feet of 20 candle-gas, what is the value of each in candle feet, and how much more valuable will the one coal be than the other for gas making purposes, when everything else is equal?

Penn coal $4{\cdot}25 \times 15{\cdot}75 = 66{\cdot}93$ candle feet.
Despard " $4{\cdot}25 \times 20{\cdot}00 = 85{\cdot}00$ " "
and $\frac{(85{\cdot}00 - 66{\cdot}93) \times 100}{66{\cdot}93} = 26{\cdot}99$ per cent.

The Penn gives 66·93 candle feet and the Despard 85; and, consequently, the Despard is worth 26·99 per cent. more than the other for gas making purposes. Or, in other words, the Despard coal will yield 26·99 per cent more light than the Penn.

Of course there are other things which must be always taken into the account, when comparing one gas coal with another, viz.—

Quantity and quality of the coke per ton.

Quantity of gas purified by one bushel of lime. The Penn, in this case, yields more coke and requires less lime for purification than the other. By using Despard coal one man can make 26·99 per cent. more gas per day, than he can by using the other.

I will now give one more example on comparisons, viz.: If one pound of coal, A, will yield 5 cubic feet of 13·60 candle gas, and one pound of coal, B, will yield 4·25 cubic feet of 16-candle gas, what is the value of each, when everything else is equal?

Coal A. $5 \times 13{\cdot}60 = 68$ candle feet.
" B. $4{\cdot}25 \times 16 = 68$ " "

As each of these coals yields 68 candle feet, they are equal in value for gas making purposes.

I will now give the table of tests made by Mr. Lamson, and add two extra columns to each table, viz.—one for the candle feet, and the other for the sperm equivalent. I will also place at the bottom of each one of the best and most important tests which he made, and gives in his interesting paper, viz.—"We tried one curious experiment as follows: Retorts were run under half inch vacuum; yield, 6·38 cubic feet to the pound of 10·91 candles; air was of course drawn in."

If we examine the results given in the 11th and 12th columns of both tables, we see that the value of the gas in candle feet, and sperm equivalents, has gradually increased as the volume increased, and as the candle power decreased. For instance, when the production from one pound of coal was only eight-tenths of a cubic foot of 19·60 candle gas, we only obtain 15·68 candle feet, and 120 sperm equivalents; but when the production was increased to 5·14 cubic feet of 13·41 candle gas, we then obtain 68·92 candle feet and 529 sperm equivalents.

A very simple calculation will now show you that the 6·38 cubic feet of 10·91 candle gas per lb. gave—

$\frac{(69{\cdot}60 - 15{\cdot}68) \times 100}{15{\cdot}68}$ = 343 per ct. more light than that of 1st test in table.

$\frac{(69{\cdot}60 - 33{\cdot}25) \times 100}{33{\cdot}25}$ = 109 per ct. more light than that of the 2d test.

$\frac{(69{\cdot}60 - 47{\cdot}24) \times 100}{47{\cdot}24}$ = 47 per ct. more light than that of the 3d test.

$\frac{(69{\cdot}60 - 56{\cdot}80) \times 100}{56{\cdot}80}$ = 22·5 per ct. more light than that of the 4th test.

$\frac{(69{\cdot}60 - 64{\cdot}09) \times 100}{64{\cdot}09}$ = 8·5 per ct. more light than that of the 5th test.

TABLE No. I.

Test 2400 lbs. of Penn Coal; 12 Clay Retorts; Charge, 200 lbs. each; Duration, 4 hours; Retort-Valves open; One-quarter Inch pressure on Retorts.

February 18th, 1876. Hours.	Meter.	Gas made each half hour.	Test of each half-hour's candle power.	Make per pound in cubic feet.	Calculated candle power of total gas at end of each half hour.	Inlet Condenser, Degrees F.	Outlet Condenser, Degrees F.	Washer, Degrees F.	Meter, Degrees F.	Candle feet.	Sperm Equivalent.
3											
3.30	193	1930	19.60	.8	19.60					15.68	120
4	440	2470	17.07	1.83	18.17	95°	66°	52	65	33.25	255
4.30	654	2140	15.73	2.72	17.37					47.24	362
5	842	1880	12.26	3.50	16.23	91°	69°	50	66	56.80	436
5.30	1000	1580	10.79	4.17	15.37					64.09	492
6	1134	1340	6.88	4.72	14.37	92°	69°	50	65	67.82	520
6.30	1210	760	2.91	5.04	13.65					68.79	528
7	1234	240	1.5	5.14	13.41	76°	66°	54	65	68.92	529
				6.38*	10.91*					69.60*	534*

* Test made with one-half inch vacuum.
The yield per Table was 11,513 cubic feet per ton, or 5·14 cubic feet per lb., of 13·41 candle gas. The yield per test with one-half inch vacuum, was 14·291 cubic feet, or 6·38 cubic feet of 10·91 candle gas.

TABLE No. 2.

February 23rd, 1876. Hours.	Meter.	Gas made each ½ hour.	Test of each half hour's candle power.	Make per lb. in cubic feet.	Calculated candle power of total gas at end of each ½ hour.	Inlet Condenser. Degrees F.	Outlet Concensor. Degrees F.	Washer, Degrees F.	Meter, Degrees F.	Candle feet.	Sperm Equivalent.
9.30											
10.	180	1800	19.60	.75	19.60	86°	66°	52°	65°	14.70	112.8
10.30	400	2200	17.95	1.66	18.69					31.02	238.2
11.	600	2000	15.34	2.50	17.57	81°	67°	54°	65°	43.92	337.3
11.30	774	1740	14.06	3.23	16.78					54.19	416.2
12.	935	1610	10.80	3.89	15.75	78°	67°	52°	66°	61.26	470.5
12.30	1068	1330	10.00	4.45	15.03					66.88	513.6
1.	1170	1020	4.48	4.87	14.11	72°	67°	54°	66°	68.71	527.7
1.30	1227	570	2.00	5.11	13.55					69.24	531.7
				6.38*	10.91*					69.60*	534.5*

* Test made with half-inch vacuum.
The yield per table was 11,446 cubic feet per ton, or 5·11 cubic feet per pound of 13·55 candle gas.

$\frac{(69{\cdot}60-67{\cdot}82)\times 100}{67{\cdot}82}$ = 2·6 per ct. more light than that of the 6th test.

$\frac{(69{\cdot}60-68{\cdot}79)\times 100}{68{\cdot}79}$ = 1·1 per ct. more light than that of the 7th test.

$\frac{(69.60-68{\cdot}92)\times 100}{68{\cdot}92}$ = 0·98 per ct. more light than that of the 8th test.

These experiments and results prove conclusively that the Gas Fraternity have been laboring under a mistaken notion, in supposing that the value of the gas decreased as the volume of the gas was increased. Instead of that being the case, by the ordinary process, the value is actually increased as the volume is increased.

I calculate that if our present process for making gas were perfect, that the said tests should have given about the following results in candle-power :

1st half hour $\frac{69}{\cdot 8}$ = 86·25 candles.

2d half hour $\frac{69}{1{\cdot}83}$ = 37·70 "

3d half hour $\frac{69}{2{\cdot}72}$ = 25·36 "

4th half hour $\frac{69}{3{\cdot}50}$ = 19·70 "

5th half hour $\frac{69}{4{\cdot}17}$ = 16·54 "

6th half hour $\frac{69}{4{\cdot}72}$ = 14·61 "

7th half hour $\frac{69}{5{\cdot}04}$ = 13·69 "

8th half hour $\frac{69}{5{\cdot}14}$ = 13·42 "

Extra test $\frac{69}{6{\cdot}38}$ = 10·81 "

The constant 69, used in the dividend of this table, was about the maximum candle feet obtained from the Penn coal, and the divisors are the number of cubic feet of gas obtained in each test.

From the time the charge is placed in the retort, to the time it is carbonized, the gas gradually gets lighter, and, consequently, it is brought to that condition at which it will take up a large amount of the hydrocarbons which are left in the apparatus and pipes by the heavier gas. This may possibly be one of the reasons why the value of the gas is increased as the volume is increased, as in the preceding tests.

I now think that the following facts ought to satisfy all that the results obtained in the eighth test of the table were much better than those obtained in the first test. The former gave 6·4 times the volume of gas obtained in the latter, consequently we have 6·4 times 13·41 candles, or 85 candles.

The gas as per yield in the 8th test will supply 6·4 argand burners, each consuming 5 cubic feet per hour, and giving 13·41 candles. The candle power of the six argand burners combined will be 6·4 × 13·41, or 85 candles, while the gas as per yield in the 1st test will only supply one argand burner consuming 5 cubic feet per hour, and giving 19·60 candles.

During the year 1868, when I was working for the Manhattan Gas-Light Company of this city, I introduced two methods for taking the candle power of rich gases, viz:—One by gas mixtures, and the other founded on the fact that the intensity of a flame from ordinary gas is as the square of the volume of gas consumed ; and in the year 1870 I introduced the gas and air, and hydrocarbon formulas for the same purpose.

As I have now a favorable opportunity for applying the Formula for gas mixtures, on the tests made by Mr. Lamson—I will adply it on those in his 1st table.

He has fortunately given us 8 series of yields, with the candle power of each, and he has also given us the sum of these yields and its candle power.

These yields varied greatly in volume and candle power. The yields per half hour ranged from 240 to 2470 cubic feet of gas, and the sum of these yields was 12,340 cubic feet.

The candle power ranged from 1.50 to 19·60 candles, and the illuminating power of the whole yield was 13·41 candles.

Now, if we multiply each of these yields by the candle power which it gave, and divide the sum of those products by the sum of the yields, the quotients will give the candle power of the whole yield as follows :

Test.	Cu. ft.		Candles.		Product.
1st.	1930	×	19·60	=	37828·0
2d.	2470	×	17·07	=	42162·9
3d.	2140	×	15·73	=	33662·2
4th.	1880	×	12·26	=	23048·8
5th.	1580	×	10·79	=	17048·2
6th.	1340	×	6·88	=	9219·2
7th.	760	×	2·91	=	2211·6
8th.	240	×	1·50	=	360·0
	12340				165540·9

and $\frac{165540{\cdot}9}{12340}$ = 13·41 candles.

Here we had 8 difierent quantities and qualities of gas to mix and bring together.

I will now give the candle power of the whole mixture, in accordance with one of the preceding tables:

Test.	Cu. ft.		Candels		Product.
1st.	1930	×	86·25	=	166462·50
2d.	4400	×	37·70	=	165880·00
3d.	6540	×	25·36	=	166854·44
4th.	8420	×	19·70	=	165874·00
5th.	10000	×	16·54	=	165400·00
6th.	11340	×	14·61	=	165677·40
7th.	12100	×	13·69	=	165649·00
8th.	12340	×	13·42	=	165602·00
	67070				1327399·34

and $\frac{1327399{\cdot}34}{67070}$ = 19·79 candles.

The second column of this table is taken from the first column of Mr. Lamson's first table, and the second column from one of mine.

This last calculation shows that the whole yield of 12340 cubic feet should have given 19·79 candles if the present process had been perfect—

or, 11513 cu. ft. of 19·79 candle gas per ton,
or, 5·14 cu. ft. of 19·79 candle gas per lb.
or, 5·14 × 19·79 = 101 candle feet.

Consequently, this calculation shows that one ton can produce by proper management—
101 candle feet–or, 5·14 cu. ft. of 19·79 candle gas

If the decimals had been carried out further in this and the other table, we should have had all the products alike.

I have now come to the conclusion that Mr. Lamson has calculated the candle power (in his sixth column) of total gas at end of each half hour, by this formula for mixtures ; and, consequently, it is not quite as satisfactory as if he had tested the same on the photometer bar.

We ought not to be very much surprised at these results, for Dr. Gesnor states in his work on "Coal and Petroleum," that one ton of Pittsburgh coal will produce 49 gallons of crude oil and also a considerable quantity of rich gas—Newcastle coal, 48 gallons ; Newburgh, 72 gallons ; Darlington, 56 gallons ; Boghead, 120 gallons ; Albertite, 110 gallons ; Breckenridge, 130 gallons.

Now, as it is generally agreed that one gallon of crude oil will produce 70 cubic feet of 70 candle gas, we certainly ought to get better results than we generally do.

It is very singular, that with the ordinary process for making gas from coal, we never obtain any rich gas, whether the yields be large or small. We never see any signs of such rich gas as that given in the preceding calculations—consequently I am certain that the present system is radically wrong.

I calculate that Mr. Lamson lost in his first series of tests, the following amount of gas:

1st ·8 — $\frac{69}{19{\cdot}60}$ = 2·7 { Cu. ft. per lb. of 19·60 candle gas during the first half hour.

2d 1·83 — $\frac{69}{18{\cdot}07}$ = 1·99 { Cu. ft. per lb. of 18·07 candle gas during the second half hour.

3d 2·72 — $\frac{69}{17{\cdot}37}$ = 1·25 { Cu. ft. per lb. of 17.37 candle gas during the third half hour.

4th 3·50 — $\frac{69}{16{\cdot}23}$ = 0·75 { Cu. ft. per lb. of 16·23 candle gas during the fourth half hour.

5th 4·17 — $\frac{69}{15{\cdot}37}$ = 0·31 { Cu. ft. per lb. of 15·37 candle gas during the fifth half hour.

6th 4·72 — $\frac{69}{14{\cdot}37}$ = 0·08 { Cu. ft. per lb. of 14·37 candle gas during the sixth half hour.

7th 5·04 — $\frac{69}{13{\cdot}65}$ = 0·01 { Cu. ft. per lb. of 13·65 candle gas during the seventh half hour.

This loss, I am confident, arises from the present system of charging the retorts.

Into a small retort, 20″ × 12″ × 8′·6″ long, we often put 260 lbs. of coal ; consequently, the temperature runs down ; the heat cannot penetrate the interior of the mass, and the production is only a vapor which is converted into a tarry oil by condensation.

For comparison, we will now convert the results from the coal oil into candle feet ; and, as I said before, one ton of Pittsburgh coal will produce 49 gallons (U. S. gallon, 231 cubic inches) of crude oil, and one gallon of the crude oil will yield 70 cubic feet of 70 candle gas—

Consequently, 2240 pounds of the said coal will produce 49 × 70 = 3430 cubic feet of 70 candle gas

or, $\frac{3430}{2240}$ = 1·5 cubic feet of 70 candle gas per lb. of the said coal.

Therefore, by the coal oil process, we obtain—
1·5 × 70 = 105 candle feet.
And, by the ordinary process, we obtain—
5·14 × 13·41 = 68·92 candle feet.

and $\frac{(105{\cdot}00-68{\cdot}92)\times 100}{68{\cdot}92}$ = 52 per cent.

Consequently, the results obtained by the coal oil process, from one ton of coal, are 52 per cent. higher than those obtained by the ordinary process for making gas.

By referring to a former statement in this paper you will see that I calculated that one ton of the Penn coal would, by proper management, produce 5.14 cubic feet of 19.79 candle gas or 101 *candle feet*, and as this result is only about 4 per cent. less than that obtained by the coal oil process I think that the said statement is not very far from the truth.

WILLIAM FARMER.

West of Scotland Association of Gas Managers.

The Fourth Yearly Meeting of this Association was held on Thursday, the 27th of April, in the Temperance Institute, Greenock—Mr. W. Dunlop, the President, occupying the chair.

We gave last week some quotations from the address of the President, and to-day we give some further extracts and the discussion thereon.

The sub-committee appointed to investigate into Mr. Malam's process of gas manufacture, are exceedingly sorry to have to report that, after making a proposal in accordance with your remit from Stirling meeting, they have failed to secure a trial of that gentleman's apparatus. The correspondence connected with this matter appeared in the *Journal of Gas-Lighting* of the 25th of January last.

It is now about four years since this process was first brought under our notice by the patentee, and it has furnished a fund for discussion at nearly all our meetings since that time, but at the present moment we are almost as wise upon the subject, and have now nearly as much information regarding it, as we had after it had been brought before us for the first time.

Somehow there has always been a lack of facts to show the real value and thorough practicability of this process; there has always been an apparent unwillingness on the part of the patentee to have his invention subjected to a sifting practical trial—a thing he ought to have hailed with pleasure, as thereby his interest might have been promoted.

A fair and candid test by our Association at his works would at once have settled the fact of its utility or non utility, but, by refusing to give assent to this test, he himself, has been the means of raising doubts in our minds. If he were certain it would prove a success, and if he himself had found it to be so, then it would have enhanced the value of the patent, and strengthened the impression in our minds that it was an invention at once simple and profitable.

It is, indeed, a pity that men will patent processes, and continue strenously to uphold them, when for their support they have not a vestage of proof, when they have nothing whereby they can maintain their position except their own bold statements, and when these bear contradictions on their face. We cannot think contradictories; and it is, in my opinion, as impossible to conceive an increase of the heat of the retort, thereby increasing the yield, without correspondingly reducing the illuminating power, as it is to conceive a figure square and at the same time round.

And now, gentlemen, it only remains for me to apologize, or rather explain some of the remarks which I made on gas-exhausters at our last meeting at Stirling. I have no doubt that most of you will have noticed, from the pages of the *Journal of Gas-Lighting*, the criticisms that those remaks called forth, and the correspondence which followed thereon. I am quite ready to admit that those remarks of mine were rather indefinite and ambiguous, but I trust to be able to show you to-day why they were so. They were thrown out more as matters of personal opinion, and I hope, when once I have explained myself, you will not consider them groundless.

The reading of Mr. Young's paper, at our April meeting at Lanark, on "the New Process of Treating Gases during Condensation," interested me very much; and I took the liberty of calling upon that gentleman at the Clippens works, to make further inquiries on the subject. He not only gave me all the information I asked, but also handed over the use of his experimental apparatus to make the necessary experiments for my own satisfaction; only stipulating that any other information I might acquire, whilst making those experiments, should be kept strictly private. I made a good many experiments on various coals and shales, and was so satisfied with the results that I recommended my committee to erect similar apparatus in the Hamilton Corporation Works, and they, after fully considering the matter, agreed to do so; and, as I have no doubt most of you know, I have it now in operation, with results, so far as I have gone, quite up to my expectation.

During the time I was making those experiments at Clippens, Mr. Young was making researches on the influence of pressure on the destructive distillation of bituminous substances under varying pressures. Those experiments, being made beside me, interested me very much—more, perhaps, on account of my having made some practical experiments in the same direction some time previously, with the view of testing the influence of exhaustion on the yield and illuminating power of the gas, and the deposit of carbon in the retorts.

Mr. Young's apparatus consisted of two very strong cast-iron retorts, connected with a condensing arrangement, on the inlet and outlet of which were fixed valves for regulating the pressure under which it was desired to conduct the distillation. As his object was more particularly directed to the relative effects of pressure on carbonization and condensation, those valves were so placed that the pressure could be either kept on the retort alone, the condensation taking place under reduced pressure, or both retort and condenser kept under similar pressures. The results of those experiments, so far as they had gone when I penned the few remarks laid before you on exhaustion at our Stirling meeting, showed that the pressure on the coal during distillation did not affect the illuminating power of the gas so much as the condensation of the gases under similar pressures. Here was a different view altogether to take of exhaustion—one that had not hitherto received attention. Most gladly would I have laid this new view of exhaustion in very plain terms before you; but seeing I was a privileged person at those experiments, and that I had promised I would not make public or any other use of what I saw, I was compelled to say nothing, or only use the language I did, and express my own opinions.

Those experiments have now been so far completed and along with the results of others covered by patent, and as I now have the liberty of the patentees to make use of the information acquired, I will, by-and-by, make up for any vagueness in my expressed opinions at our Stirling meeting.

The pressures under which those experiments were made ranged from ½ to 2½ atmospheres. The effects on the destructive distillation and condensation under those varying pressures were very various.

As a general rule, when the heats were high on the retorts, a comparatively small increase of pressure very much reduced the illuminating power, but rather increased the yield; on the other hand, when the heats on the retorts were medium or low, a very considerable increase of pressure had very little effect on the illuminating power; and, in some cases, with certain coal, at low or medium heats, pressure slightly increased both the yield and illuminating power of gases.

The effects of pressure during the condensation of gases were very different from those of carbonization, for at whatever temperature the coal had been carbonized, an increase of pressure during condensation caused a lowering of the illuminating power of the gases, and *vice versa*, a diminution of the pressure caused a very considerable increase in the illuminating power. This difference in the illuminating power ranged, under different circumstances, to the extent of from 2 to 30 per cent.

The general conclusion to be drawn from those experiments being—

A. That at very high heats, pressure on the coal being carbonized should be carefully avoided.

B. That at medium or low heats, pressure on charge has not an injurious action, but in many cases the opposite, tending to assist the heat in the decomposition of the coal into gaseous bodies.

C. That in all cases it is advantageous to relieve the pressure as much as possible during condensation, as thereby the illuminating power is much enhanced.

We all know that it is impracticable to make any considerable reduction of pressure on the coal carbonized inside the retorts; all we dare do (and what has hitherto been believed by many as all that was required) being to bring down the pressure to that of the atmosphere, or, in other words, relieve the retorts of the working pressure; because if we go further, the air or products of combustion find their way through the pores of the retort amongst the gases produced from the coal. In my opinion it even becomes very questionable if it is desirable to bring down the pressure to within 4 or 5 inches of the surrounding atmosphere, as it is a fact that whenever the pressure comes below this, the law of the diffusion of gases comes powerfully into play, and although we may, by a further reduction of pressure, prevent a little leakage, yet we increase the infusion into the retort of the air or products of combustion to a much greater extent; indeed, I am satisfied that the lessening or the removal of the deposit of carbon by the use of an exhauster is, to a considerable extent attributable to the air thus infused, and removing it in the form of carbonic oxide.

There is one thing of which I am perfectly satisfied, and that is, that the leakage through the pores of the retort, under the ordinary working pressure, is not anything like the amount of gain in volume said to be obtained by the use of an exhauster. We often hear of parties increasing their yield 10 per cent. by the use of an exhauster. Now, I have one of Mr. George Anderson's exhausters, and have made many trials without this exhauster, and I must say that, where similar heats were used, I never yet could say that I increased my yield 2 per cent., unless I allowed over-exhaustion on my retorts, when I both got quit of my carbon and increased my yield. Of course, I knew that my increased yield was coming from the furnace, and not from the coal in the retorts. I have tried, and I invite you to try, similar experiments, to test the amount of leakage through the pores of an ordinary fire-clay retort. Bore and attach a malleable iron pipe to a retort door, connect this with a small test gasholder filled with gas, and loaded to within a few tenths of your ordinary working pressure, only taking care that the seal in the hydraulic is not overcome, then allow the whole to stand till the gasholder is emptied, and note the time, and the results will at once prove to you how tight clay retorts are as ordinarily worked. Or another experiment. Take a piece of coal, say two pounds, and place it in the retort mouth, but sufficiently back to distil slowly. If you do this, some day when the retorts are laid off, you will hear the gas as it passes in bubbling through the water in the hydraulic for two or three hours, thus showing that two pounds of coal, say, under the circumstances, making only 8 cubic feet of gas, supply all the leakage taking place for three hours, and leave a surplus to bubble into the hydraulic.

Such are the results when the ordinary working pressure amounts to four or six inches and more; but the case is very different when the pressure is much lower. For, as you all know, should the retorts be left idle for some hours, and no pressure be exerted from gases generating within they, on again being charged, show leakage; and in a similar manner, when the working pressure is removed, or nearly so, by the exhauster, the retorts also become leaky, and should the exhauster be stopped, the leaky condition of the retorts will be at once seen; but by allowing the pressure to remain on the retorts, they will become very soon, to all appearance, tight.

Now I think this can easily be explained in the following manner:—So long as the pressure inside the retorts exceeds four to six inches, the diffusive action of the gases through the porous septa of the clay retort is almost arrested, because the transpiration of the coal gases, produced by the pressure, overcomes this diffusive action, thereby causing the denser hydrocarbon vapors to pass in through the minute pores of the clay retort, where undergoing decomposition, the carbon of their constitution is deposited, and plugs the minute pores in the clay retort. And as the air is prevented, or nearly so, from being diffused into the retort by the pressure, the carbon is not burned out by the oxygen.

On the other hand, where there is very little or no pressure inside the retorts, the transportation of the gases entirely ceases, and the law of diffusion comes powerfully into play, and for every volume of coal gas that passes outward through the walls of the retort, from one-half to one third volume of air passes inward, and, of course, in its passage meets and combines with the escaping gases, or with the carbon deposited from them, and thus consumes them, and instead of the pores of the clay being plugged up with the deposited carbon, the retort is thus kept open and porous; and hence the reason why, when an exhauster is employed, the purified gases always contain a comparatively large volume of nitrogen, and also the reason why, when exhausters are suddenly thrown out of action, the retorts show such an amount of leakage. I think this also points out the true reason for the lessened deposit of carbon, it being simply burned or consumed by the infused air.

Now, although I deny that exhaustion, as ordinarily conducted, increases the yield of gas 10 per cent., or in other words prevents leakage to that extent, I do not wish it to be understood that I do not believe in the utility of removing the pressure on the coal during carbonization, as when high heats are employed I am satisfied that it is very important to relieve the pressure. Because, as proved by the experiments I have referred to, the richer hydrocarbons are more rapidly decomposed by high temperatures, when under pressure, than when rarefied and allowed to pass quickly from the retort. And not only is the rarefying action of the exhauster on the gases inside the retort of considerable advantage in preventing the over-decomposition of the hydrocarbons, but it also, as proved by the experiments already referred to, assists the gases in retaining those hydrocarbons in suspension, and thereby increases their illuminating power. Most of you, I have no doubt, will remember the experiments made by Mr. Young, with the volatile hydrocarbon, at our Lanark meeting; where he showed that equal volumes of gases, under whatever pressure, absorbed and held in suspension equal volumes of the vapors, and that by increasing or decreasing the volume of a given quantity of gas, by respectively relieving or increasing the pressure, their capacity to absorb the vapors of hydrocarbons were proportionately increased or decreased. You will also remember how he showed that the affinity of the gases and the tars for the hydrocarbons, so to speak, balanced each other. Keeping those facts in mind, we can easily see that relieving the pressure, during the condensation of gases, tends to increase their illuminating power. For by relieving the pessure we increase the volume of the gases, thereby increasing their capacity for absorbing hydrocarbon vapors. Those vapors they receive from the tars, and by being passed on and removed from the influence of the tars before the pressure is replaced. they are able to retain and hold those vapors permanently suspended through them. The amount of exhaustion, or in other words the extent to which we can relieve the pressure on the retorts, is limited from their porous nature; but such is not the case with the condensers, constructed as they are of an impervious material, and of sufficient strength to resist the pressure of the atmosphere. It is therefore evident that we may, to a much greater extent, take advantage of the rarefying action of the exhauster in enabling the gases to take up and retain the vapors of hydrocabons, suspendable through them, and adding considerably to their illuminating power.

I dare say most of you who have read the correspondence in reference to the subject, in the *Journal of Gas Lighting*, will remember the flat denial given to the assertions I made, that barometric or atmospheric pressure affected the manufacture of illuminating gas quite as much, if not more than artifical exhaustion—*i.e.*, that the lowering of the barometrical pressure had quite as benefical an effect on the production of gas as the lowering of the pressure by artifical exhaustion, and, consequently, works located at considerable elevations should produce a greater volume of gas with a higher illuminating power, or, in other words, a greater height of gas from a given coal than works at sea level, even with an exhauster. The benefits claimed for the lessening of the pressure by artifical means are—

1. That it prevents leakage through the porous walls of the clay retorts, and that there is consequently an increased yield of gas.

2. That the products of distillation are protected from over-decomposition by being rarified or expanded, and that, as a consequence, the gas has a higher illuminating power.

3. There is a lessened deposit of of carbon on the inside of the retorts.

4. The stand-pipes are not so liable to be choked with solid products, and I think I may now also, with equal fairness, say—

5. The suspenion of an extra volume of vapors of the volatile illuminants ordinarily left in the tars.

Now, in my opinion, the experiments I have already referred to, go to show pretty clearly that there is no substantial gain in employing an exhauster to over-come the working pressure and prevent leaeage through the porous clay tetorts, yet of all the above lists of benefits restltiug from the use of an exhauster, this is the only one which does not equally result from a reduction of atmospheric pressure.

To illustrate my meaning, I will suppose a ton of Lesmahagow coal, carbonized at the following places, under a working pressure equal to a column of water 13 inches high, but under varying barometrical pressures due to their location as to altitude—viz, Glasgow at sea level, and having a mean barometrical pressure of 30 inches of mercury. Lanark between 700 and 800 feet above sea level having a mean barometrical pressure of 29 inches of mercury. Also Madrid and Mexico, being respectfully located 1995 and 7471 feet above sea level, and having a mean barometrical pressure of 27-72 and 22 52 inches of Mercury.

At Glasgow there would be produced, from a ton of Lesmahagow coal, 13,000 cubic feet of gas, and tars containing upwards of 2½ gallons of such a naphtha as this which I now hold in my hand. As you all know, this naphtha, or hydrocarbon fluid, is capable of volatillizing into a gas, and remaining permanently diffused through it. From experiments I have made, I find that such a gas as hydrogen can take, at ordinary temperatures, about 4 per cent. of its volume of the vapor of this hydrocarbon. Now, if during the distillation of the coal there had been added, at the paoper time, hydrogen in sufficient quantity, the whole of this 2½ gallons of naphtha would have been converted into the gaseous state. This has been, over and over again, proved by what is known as the ,, hydrocarbon gas-making process." Were it by any means possible to expand the coal gases to a greater volume, they would themselves be able to take up and hold in diffusion the vapors of this naphtha.

If a ton of Lesmahagow coal was distilled at Lamark, at a similar temperature to that employed at Glasgow, there would be produced a similar quantity of permanent gas. But, as the pressure at Lanark is only equal to 29, instead of 30 inches of mercury, the volume would be expanded by about 448 cubic feet, and consequently there would be produced 13,448 cubic feet of gas. Now, this increased volume of gas would be able to take up an increased quantity of the vapors of the naphthas simultaneously produced amounting to, as tested by experiments (were no other affinities brought into action), 4 per cent. of the increased volume. But, as shown us by Mr. Young at our Lamark meeting, the tars have an affinity for the naphtha vapors; and, therefore, I will suppose that the increaed volume of gases only absorbed one-half of the found quantity, or 2 per cent. This would increase the volume of gases to 13,457 cubic feet, and their weight, calculated for the vapor deusity of this naphtha, by about 14·065 grains, or fully one grain per cubic foot. This weight of naphtha vapor I have found, when added to the gas from Lesmahagow coal, to increase its illuminating power about 0·80 of a candle; and, therefore, there would be at Lanark an increased sperm value of about 37 lbs.

Again, at Madrid and Mexico, under very much greater reductions of atmospheric pressure, the volume of the gases would be very much greater; and, consequently, the quantity of naphtha diffusible through their increased volume of gases would be much larger.

The following table gives the elevation of the seveaal towns, the mean barometric pressure, and calculated results:

Table of Comperatiee Results from One Ton of Lesmahagow Coal, under various Barometrical Pressures.

Name of Place.	Height above the Level of the Sea.	Mean Height of the Barometer.	Calculated Volume of Gases due to Mean Barometrical Pressure.	Increase of Volume.	Extra Weight of Hydrocarbon Vapors suspendible by reason of increased Volume of Gas.	Calculated Total Increased Volume of Gas from Reduced Atmospheric Pressure and Suspended Hydrocarbon Vapors.	Increase in Sperm Value.
	Feet.	Inches of Mercury.	Cubic Feet.	Cub. Ft.	Grains.	Cubic Feet.	Lbs.
Glasgow ...	...	30.00	13,000	...	...	...	...
Lanark	760	29.00	13,448	448	14,229	13,457	37.00
Madrid	1995	27.72	14,069	1069	31,527	14,069	86.82
Mexico	7471	22.52	17,318	4318	127,467	17,404	356.19

In a similar way, and for similar reasons, the over-decomposition of the products of distillation will be prevented by the reduction of atmospheric pressure; for, as the gases are stored in the gasholhers under reduced pressures (in the case of Mexico, the mean pressure being only equal to 22·52 inches of mercury), the gases will be generated from the coal inside the retort under this pressure—*plus* the working pressure —equal to, say, another inch; making, in all, 23·52 inches of mercury. Before coal could be distilled under similar pressures at Glasgow, there would require to be produced a vacuum, or lowering of the pressure isnide the retorts below that of the surrounding atmosphere equal to a column of mercury 6·48 inches high, or equal to a column of water 7 feet high.

Of course, we all know this to be impracticable from the nature of our retorts, and, consequently, with the most perfect exhauster, we cannot produce conditions so beneficial for the production of illuminating gas from coal as that produced naturally from the reduced atmospheric pressure due to the elevated location of a work.

Having now, in a very cursory manner, laid my view on exhaustion before you, I do hope that, by free discussion, you will express your opinions upon this subject. In the meantime, allow me to thank you for the patient hearing you have given to these remarks.

Mr. Key took exception to some of the remarks in the president's address, which he thought were too personal. He further said the president did not believe the exhauster had any beneficial result in relieving the pressure from the retorts. For himself, he had noted, within the past few months, that, when the exhauster at his works was out of action, he lost 30s. worth of gas every hour.

Mr. YOUNG: I think it is scarcely fair to accuse the president of making this a personal matter, for it affects the Association. Certain remarks which he made at the Stirling meeting were taken up by outsiders in the *Journal of Gas Lighting*, and I consider that the president was bound to say something in justification of himself at this meeting. I do not think it is fair to exclude the president from explaining language used at that meeting.

Mr. M'EWEN: What is the weight of gas which appears to be taken from a ton of coal at Mexico, and are there tar and other matters as well as gas?

The PRESIDENT: This is a table based upon ascertained laws. I was not at Mexico to obtain actual figures, but I said such should be the case, and that there should be got an increased illuminating power, equal to 356lbs. of sperm, out of the naphthas that are left in the tar from Lesmahagow coal.

Mr. M'EWEN: Is the effect of this pressure fact or theory?

The PRESIDENT: You may call it theory, if you wish; but the atmospheric pressure at the places named is an ascertained fact, although these figures may be open to criticism.

Mr. YOUNG: Having, along with the president, made a series of experiments on exhaustion in connexion with the new process, and in connexion with other improvements in the manufacture of gas, I shall perhaps be excused if I make a few remarks on the laws wnich regulate the diffusion of hydrocarbon vapours through gases. If we take a certain quantity —say a cubic foot—of gas, we shall find that it takes up a given number of grains of any volatile hydrocarbon brought in contact with it; if we then expand it to two cubic feet, it will take up double that quantity of vapours, for, under whatever tension the gases may be, equal volumes will take up equivalent quantities of the vapours of hydrocarbon. Now, it may be theory, so far as the president has reasoned out the question of the influence of artificial exhaustion on leakage through the pores of the clay retort; but his theory is founded on known facts. We know that, by adding a volume of hydrogen to any of the rich cannels during distillation, that volume of hydrogen takes up an equivalent portion of hydrocarbon vapours left in the tar, and forms with them an illuminating gas. This has been found over and over again in working the hydrocarbon process. Therefore, if hydrogen, added to a very rich coal, takes up an extra volume of hydrocarbon, and if the gases, when expanded, have an equivalent power in suspending naphtha vapours, it can be easily conceived that, under reduced atmospheric pressures, the volume of gases will be proportionately expanded, and consequently the results should be similar to those given in the table referred to.

Mr. M'EWEN: Do you add to that ton of coal the hydrogen? because if you do, you increase the bulk.

The PRESIDENT: There is nothing added to the coal. It is just the air being rarefied which allows the gas to expand to this increased volume.

Mr. YOUNG: Do you mean to add hydrogen to increase the volume? Such is not the case, and at Mexico such is not required, because there the permanent gases, or the 13,000 cubic feet which would be produced at Glasgow from the coal, would be expanded, as shown by the table, to 17,318 cubic feet. This extra volume would exactly act the part of 4,000 odd cubic feet of hydrogen added to the gases at Glasgow, and as there is something like 2½ gallons of naphtha in the residuary tars, if these naphthas were presented to the expanded gas, that expanded gas would take them up and hold a considerable portion of them in diffusion as perfectly as is needed to convey them to the consumer, and that is all that is desired. There would be no extra weight of permanent gas, but there would be an extra weight of the diffused hydrocarbon vapours added to the gas, and that extra amount of vapour would give extra illuminating power equal to 336 lbs. of sperm. That should be, so far as ascertained facts would indicate, the result; but whether such would be the result would require to be found out at Mexico.

Mr. KEY: I think the chairman remarked that if we reduce the pressure by exhaustion at Glasgow, so as to relieve the weight of the atmosphere, to correspond with the weight at Mexico, it would equal 6 inches of mercury, or 7 feet of water.

The PRESIDENT: I said that at Mexico we had less pressure by that amount.

Mr. KEY: You said if we worked the exhauster properly we should relieve the retorts to that amount.

The PRESIDENT: I never said such a thing.

Mr. YOUNG: What he said was this. That before he could get coal distilled in Glasgow under like conditions, he would require to relieve the pressure of the atmosphere equal to a column of mercury 6 inches high; but he said this was a physical impossibility, for the simple reason that the retorts were porous, And, therefore, were we to relieve the pressure to this extent, the air would rush into the retorts and mix with the gas, and you know what the result would be.

Mr. KEY: We have no reality but theory, and this theory about the presence of the atmosphere is wrong, because we are working with closed retorts from which the atmosphere is entirely excluded.

Mr. YOUNG: How are you able to bear 15 lbs. weight of atmosphere on every square inch of your body, amounting over the whole surface to many tons? Simply because there is an equal pressure from the inside. Inside a gasholder there is a pressure equal to that on the outside, *plus* the added weight of the gasholder. The gasholder is in direct communication with the inside of the retorts, and as the mean pressure on the gasholders at Glasgow is equal to 15 lbs. on the square inch, or equal to a column of mercury 30 inches high, and as that pressure must be pressing back into the retorts with an equal weight of 15 lbs. per square inch, *plus* the working pressure, it is evident that when working the exhauster at level gauge there would still be an equal pressure of 15 lbs. per square inch on the coal undergoing distillation inside the retorts. All that would be done by the exhausters would be to overcome the working pressures and lift the gasholder. At Mexico the case is different. There is a mean pressure of only 22 inches of mercury bearing down upon the gasholder, and consequently only 22, *plus* the working pressure, inside the retort. Now, if you are working under conditions where the mean pressure is only 22, as indicated at Mexico, instead of 30 inches at Glasgow, the gases will be produced under a much lower pressure than they could possibly be produced by the use of an exhauster at Glasgow. And further, in a town such as Mexico, where the air is in a more rarified condition, the gases are stored and conveyed to the consumer in their expanded state, and consequently they are able to retain more of the hydrocarbon vapours in diffusion, whereas in Glasgow the gases, however much relieved by artificial exhaustion during their manufacture, must be stored and distributed under a much greater pressure, and so will have a lesser power of retaining hydrocarbon vapours in diffusion. Or, in other words, if 13,000 cubic feet, being the manufacture from a ton of Lesmahagow coal at Glasgow, take up a given volume of hydrocarbon vapours, 17,000 odd cubic feet, being the volume of the gas at Mexico, will take up an equivalently greater quantity of hydrocarbons, and that extra weight will be in the gas, and will add to its luminosity.

Mr. KEY: We are as well here as at Mexico, and it is a physical impossibility that we should be able to work our exhausters at a vacuum of seven feet of water.

Mr. YOUNG: I may as well again state that as in this country we are always working under a greater pressure than at Mexico, if it was possible, during the process of condensation, to keep our gases expanded to the same extent as at Mexico, from the lower atmospheric pressure there, when in contact with the tar, they would have, to a greater extent the power of holding on to the hydrocarbons produced along with them; so that if, during the process of condensation, we could by any simple means double the volume of the gases, we should double their power of holding on to the hydrocarbons suitable for carburetting a gas, and as we all know, if we take the tars and distil them, and pass the gases over the separate naphthas, we find that the gases have the power of taking up and holding in diffusion a considerable portion of those naphthas, thus clearly showing that the tars have a counteracting effect in preventing the diffusion of those vapours during the process of condensation; and, therefore, if we expand the gases during the condensation, we, so to speak, increase their power to overcome the counteracting absorptive action of the tars. Thus if, during the process of condensation, we can expand the gases to double their volume, convey them away from the tars in this expanded state, and afterwards allow them to shrink up, they would be able to hold on te nearly all the hydrocarbons which they had taken up from the tars whilst in an expanded state. It is a fact that by an inversion of the process—that is, by condensing the Lesmahagow gas under very considerable pressure, during the process of condensation—the illuminating power may be reduced to 13 candles, which, had they been condensed under the ordinary pressure, would have had an illuminating power of 30 candles. I may state further that there is a process being applied for the extraction of hydrocarbon vapours from shale and coals, by simply compressing them until the vapours separate. It can be easily understood that if we do the reverse of this, and expand them, we shall make gases hold an extra quantity of hydrocarbon vapours in diffusion.

The PRESIDENT: There can be no doubt that if Mr. Key lost 30s per hour, his retorts must have been in a leaky condition on account of his working at level gauge.

Mr. KEY: I did not say a loss of 30s by level gauge.

The PRESIDENT: When you were not using your exhausters, your retorts showed they were not in the condition in which they ought to be.

Mr. M'GILCHRIST: He said that when he was not working with his exhauster, he lost 30s per hour, while the president is of opinion that the thing can be done as well without an exhauster as with one. We must all tell our experience, in order to get at the truth; but we are indebted to Mr. Key for introducing this little bit of discussion on the president's paper, seeing it has elicited so many striking illustrations.

Mr. YOUNG: Before closing this discussion, I would like to make another remark. It is rather a wonderful thing that, if we reduce the pressure down to within two inches of the atmosphere, the law of diffusion appears to come so powerfully into play as to cause an effusion of gas and an infusion of air to such an extent that the gases meet, combine, and consume each other in the pores of the retort; and, although we look into the retort-oven, we see nothing coming through these pores, because it is met in its passage by the free oxygen and consumed: but still there is leakage from diffusion going on through the pores of the retort. If we heighten the pressure, the gas shows itself on the outside, for the simple reason that the law of transpiration coming into play causes the denser gases to pass into a relatively much greater quantity; but by keeping the higher pressure on the retorts for a little while, as we all know, they will soon become tight, becaure the denser hydrocarbons are decompoeed as they are transferred through the pores of the retort, and the deposit of carbon closes up those pores, and the consequence is that we have a retort quite as tight, if not tighter, under considerable pressure, as the same retort would be kept at level gauge. And I know many country gas-works where they are taking out the full quantity of gas from the coals which they use, and where no exhauster is employed.

A vote of thanks was accorded to the president for his paper.

[From the London Journal of Gas-Lighting.]

The Supply of Gas to the Metropolis.

BY MR. HARRY CHUBB.

THE POLICY OF COMPETITION.

As to the exclusive right to the supply in any particular district, Mr. Chubb remarks that Parliament seem to have taken pains, at a very early period, to define the mode in which gas should be introduced into London, inasmuch as they issued a commission in 1822, to inquire into the subject. The commission was presided over by the celebrated Sir William Congreve, who advocated strongly, and the commission adopted his views in this respect, that only one company should be allowed in any district of the metropolis. The wisdom of this advice has been amply proved by subsequent experience; but, at the time,

the recommendation of the committee was not adopted, as, although the companies were incorporated for the supply of certain defined districts, the exclusive supply of that area was not conferred upon them, and very soon—as soon, indeed, as it was proved that the speculation was unattended with risk, and that gas could be made and supplied at a profit—Parliament encouraged competitive undertakings, by giving their sanction and approval to new companies.

The author supplies a table showing the rates of dividend paid by the several metropolitan gas companies in the earlier years of their establishment, from which it appears that from 1812 to 1817 the Chartered Company, who were incorporated in 1810, paid no dividends. In 1817 they paid six per cent.; and in the five following years 8 per cent.; in 1823, 7½ per cent.; in 1824, 7 per cent.; in 1825, 6½ per cent; and from that time down to 1840, 6 per cent. In the case of the Imperial Company, established in 1821, no dividend was paid at all until 1824, when they paid 2 per cent.; in 1825, 4 per cent.; in 1826, 5 per cent.; in 1827, 3¼ per cent.; in 1828, *nil*; from 1829 to 1839, 5 per cent.; and in 1840, 5½ per cent. Although, as he remarks, the old companies had up to that time paid very indifferent dividends, speculative investors were found willing to embark their capital in new undertakings empowered to supply districts already served, under the authority of Parliament, by the old companies.

In pursuance of this policy, the Independent Company were established, in 1829, to compete with the Imperial; the Equitable Company in 1831, to compete with the Chartered; the London Company, in 1844, to compete with the Imperial, the Equitable, and the Chartered; the Great Central, in 1848. to compete with the two companies supplying the city, and the Surry Consumers, in 1854, to compete with several companies on the south side of the Thames. The Western Company were also admitted by the several vestries, without parliamentary sanction, in 1850, to compete with the Chartered, the London, and the Imperial. These several competitive companies were generally formed and promoted by bodies of consumers working in concert with the local authorities, through whom contracts were obtained at low prices for the supply of gas to the public lamps. In this manner a footing was gained in a district, and competition secured. Under this system, which prevailed from 1830 to 1857, many of the public thoroughfares were occupied by the mains of as many as four different companies, each of whom required to open the roadways frequently to make connections with, or to repair, their respective mains. It was, of course, impossible to distinguish one set of mains from another, consequently one company would frequently obtain a supply for their customer from another company's main. It was also impossible to say, when there was any escape of gas, from which company's main the leakage might be, hence all the companies opened the ground, and the surface of the road was scarcely ever at rest. The companies incurred great loss from the outlay of capital for four sets of mains where one would have sufficed, as well as loss of gas by leakage, owing to the difficulty of keeping the mains in proper repair, and the public suffered great inconvenience from the confusion naturally resulting from such a system.

The result of this competition also, so far from cheapening the supply of gas to the public, only led to increased expenditure, and eventually to an arrangement between the competitive companies to charge a uniform price, and to make the best dividends they could on their capitals, a considerable amount of which had been expended uselessly in laying several sets of mains in competition with each other. This led to the adoption by the companies themselves generally, in 1857, of the system recommended by Sir William Congreve, viz., of dividing London into districts, each to be supplied by one company, whereby they improved their own position, without in the slightest degree prejudicing the interests of the public. The argument, that by means of competition the public would get cheaper gas, is utterly fallacious, inasmuch as, according to a very true apothegm of the late Mr. Robert Stephenson, "when combination between two or three public companies is possible (their number being necessarily limited), competition is impossible," for, of course, they will not long continue to ruin each other for the benefit of the public, nor are there any means of compelling them to do so. Moreover, experience has shown that, since the abandonment of competition between the London gas companies, the price of their gas has been materially reduced, to the great advantage of the consumer, as might reasonably have been expected from the greater economy in the distribution of gas resulting from it.

METROPOLITAN GAS ACT, 1860,

The writer says the public have a horror of the name of "monopoly," and, therefore, as soon as the companies had resolved to divide London into districts between them, the consumers raised a great outcry, on the plea that, hereafter, the price of gas might be increased. and that, being at the mercy of only one company, the public would have no means of redress. This agitation led to long inquiries before parliamentary committees in 1858, 1859, and 1860, and, eventually, to the passing of the Metropolis Gas Act of 1860, which distinctly recognized the wisdom of the course pursued by the companies, and the expediency of allowing only one company in each district of the metropolis; but, at the same time, it placed all the companies under most severe obligations and restrictions for the benefit of the public, both as to price, illuminating power, purity of their gas, the maximum rate of their dividend, and other matters, as the condition of their enjoyment of a monopoly.

POPULAR PREJUDICES AGAINST GAS COMPANIES.

In seeking to find some justification for the attitude which the local authorities assume towards the companies, our author admits that the companies are certainly by no means popular bodies. One is accustomed to hear them spoken of everywhere, and by almost every one, by the most opprobious terms. They are accused among other things of being overbearing towards their customers—exacting in their charges—supplying abominably bad gas—of being able in some way, how, no one else knows, to make meters register a much larger quantity of gas than can possibly have been consumed—of lighting the public streets most indifferently—of always disturbing the roadways in the streets unnecessarily. and never properly repairing them after disturbance—and of making fabulous profits out of the much injured consumer, which profits it is asserted are either distributed among the shareholders, in some occult way, far in excess of their authorized dividends, or are spent recklessly in paying princely salaries to the directors and officials.

This selection from the catalogue of crimes attributed to the metropolitan gas companies are matters of almost general faith—but a few facts and words of explanation ought to satisfy any reasonable person that there is no foundation whatever for any of these accusations. The alleged overbearing conduct is probably due in some measure to the necessity which exists for the companies to ask their consumers to pay their accounts with some degree of punctuality. But the London companies, in order to spare their customers as much trouble as possible, collect their accounts, not monthly, as they do in many of the towns in the provinces, in all the continental cities, as well as in all the cities in the United States, but quarterly. No part of the duty connected with the management of a gas company is so trying as this collection of debts. In London the accounts of those residing in private dwellings, even in the wealthier districts, average only £11 a year, or £1 15s. in autumn quarter and £3 15s. in winter, and as the companies have to pay for all the coals they consume, as well as the wages of the large number of men they employ, week by week, it is essential to economy and good management that the moneys due to the companies should be collected as promptly as circumstances will admit. Experience has proved also that long credit results in bad debts; and, as a proof of this forbearance of the London companies, it may be stated that their losses from bad debts amount to about £14,000 a year, or nearly one-half per cent. on the total amount of their receipts arising from the sale of gas. In the other cities referred to where the collection is made every month, and where no such forbearance is shown as in London, a bad debt is unknown.

ILLUMINATING POWER OF LONDON GAS.

The standard of illuminating power for the gas supplied in London has been fixed at 16 candles, for the reason that no higher illuminating power can be produced without the use of a very large quantity of rich "cannel" coal. Even 16-candle quality require the admixture of nearly 10 per cent. of that coal with about 90 per cent. of certain descriptions of Durham coal. Good cannel is becoming very scarce, and therefore costly, and the coke which is produced from it is of very inferior quality. The price of cannel has gone up nearly 50 per cent. within the last few years; the owners of it are very few in number; and it is obvious that if the illuminating power in London were raised so as to compel the companies to employ that description of coal exclusively, or even in much larger quantities than at present, they would be placed at the mercy of the cannel coal owners, and it would be utterly impossible to supply gas in London at anything like the present prices.

CONSUMPTION OF CANNEL COAL.

The writer, in an earlier part of his paper, stated that the quantity of coal now consumed in London amounts to 1,500,000 tons per annum, and a reference to a table here given shows that the total yield of cannel of all kinds amounts to no more than 1,418,176 tons per annum, a large proportion of which is quite unfit for the purpose of gas manufacture.

Total quantity of Cannel of all kinds produced in 1865 by all the Collieries in the United Kingdom, as ascertained by Mr. Robert Hunt, F.R.S., Keeper of Mining Records in the Government School of Mines in Jermyn street.

England	946,176	tons.
Wales	150,000	"
Scotland	322,000	"
	1,418,176	"
Of which there were used for distillation for coal oil	250,000	"
	1,168,176	"

NOTE.—The above table, although referring to the year 1865, may be taken as fairly representing the yield of cannel of all kinds in the year 1875, with the exception, perhaps of Scotland, where there may have been some increase. The quantity of cannel used by the metropolitan gas companies in the year 1875, for the purpose of enriching the gas made from Dublin coal, amounted to 84·310 tons.

MAIN AND SERVICE LAYING AND STREET LIGHTING.

As to the disturbance of the roadways in the streets, the most convenient and appropriate place in which the gas mains might be laid is undoubtedly underneath the pavement of the side walks as in most foreign cities; but in London the cellars of the houses extend underneath the whole of the side pavements, the arches of which are so near the surface as not to admit of the pipes being laid between them and the pavement; and after any roadways may have been disturbed for the necessary main laying, the local vestries refuse to allow the companies to make good the surface; they claim to do this work themselves, with a view, apparently, of making some profit out of the companies by so doing. The vestries, and not the companies, are therefore answerable for any defects in the restoration of the roadways, if such there be, after main-laying. The vestries are also responsible for all the odium which attaches to any defective lighting of the public thoroughfares; the companies merely provide and supply the gas, whilst the vestries determine the number and position of the lamps as well as the size of the burner which regulates the quantity of gas to be supplied, and for which they are to pay; so that, if through the parsimony of the local

authorities, the street-lamps are not sufficiently numerous, or the size of the gas-flame is not so large as it ought to be the companies are in no way to blame: they are, in fact, powerless to make it otherwise. Comparing London and Paris in this respect, it may be sufficient to state that in the former, the area of which is 77,997 acres, there are 54,119 public lamps, whilst in the latter there are 38,498 in an area of 19,299 acres.

METER-TESTING.

A very slight acquaintance with the mechanical contrivance of a gas-meter ought to satisfy any impartial mind that by no human ingenuity can it be wilfully driven onward, so as to oblige the consumer to take more gas than he desires, or to registar more than he actually burns. If a meter errs at all—and every machine is to a certain extent imperfect—the liability so to err is in favor of the consumer. But the Legislature has not been unmindful of those who feel dissatisfied, and feel also disqualified to look into this matter for themselves; official inspectors of meters and official meter-testing offices are provided in several convenient places in the metropolis, where impartial and skilled evidence may be speedily obtained at a trifling expense.

RATE OF INCREASE IN THE CONSUMPTION OF GAS.

The increase in the consumption of gas throughout London is fairly illustrated by the annexed table, relating to the extensive district of the Imperial Company, over a period of twenty-five years ending 1874, during which the annual consumption has increased fourfold, and the quantity consumed on the day of the greatest demand in each year which is always on the day preceding Christmas Day, has increased at a still larger ratio, being more than fivefold. It is for this day of the greatest demand, which, in the case of the Imperial, exceeds any other day by about two millions of cubic feet, that the capabilities of the several companies works must be prepered and maintained, and this of necessity involves the outlay of a very large amount of capital for works which are required for the service of this limited season of the year only.

IMPERIAL GAS COMPANY.

Table showing the Rate of Increase in the demand for Gas from 1850 *to* 1874 *inclusive, over the same Area of Supply.*

Year.	Total Quantity delivered during the Year.	Increase per cent. One Year.	Five Years.	Ten Years.	Largest Quantity delivered in one day in the year.
	Cubic Feet.				Cub. Feet.
1850	898,031,942	5·9	43·1	100·4	4,193,000
1851	984,631,416	9·6	41·9	112·0	4.866,000
1852	1,102,680,708	12·0	43·1	131·4	4,993,000
1853	1,236,861,400	12·2	52·1	149·6	6,178,000
1854	1,318,349,000	6·6	55·5	141·9	6,657,000
1855	1,460,391,000	10·8	62·6	132·7	7,531,000
1856	1,548,347,000	6·0	57·0	125·3	7,710,000
1857	1,608,306,000	3·9	45·8	108·7	7,800,000
1858	1,692,336,000	5·2	36·8	108·1	8,545,000
1859	1,808,960,000	6·9	37·2	113·4	9,811,000
1860	1,981,913,000	9·6	35·7	120·7	10,008,000
1861	2,038,887,000	2·9	31·7	112·3	9,662,000*
1862	2,153,909,000	5·6	33·9	95·3	11,203,000
1863	2,212,411,000	2·7	30·7	78·9	11,585,000
1864	2,463,989,000	11·3	36·2	86·9	13,087,000
1865	2,637,222,000	7·0	33·0	80·5	14,254,000
1866	2,838,701,000	7·1	39·2	83·4	15,724,000
1867	2,992,832,000	5·4	38·9	86·1	15,971,000
1868	3,019,000,000	0.9	36·5	78·5	17,023,000
1869	3,169,444,000	5·0	28·6	75·2	17,396,000
1870	3,364,524,000	6·2	27·6	69·7	19,603,000
1871	3,559,857,000	5·8	25·4	74·6	20,394,000
1872	3,661,583,000	2·9	22·3	70·0	19,953,000
1873	3,856,018,000	5·3	27·7	74·3	19,879,000
1874	3,998,059,000	3·7	26·1	62·3	23,352,000

* This falling off is attributed to the death of the Prince Consort, which occurred on the 16th of December in this year.

NOTE.—Five per cent, at compound interest = 63 per cent. in ten years.

Six per cent. at compound interest = 79 per cent. in ten years.

Seven per cent. at compound interest = 96 per cent. in ten years.

SUPPLY OF GAS TO THE WORKING CLASSES.

The author points out that the increase of consumption is steadily going on, although the rate has fallen off somewhat during the last five years; there are, however, a very large number of houses yet to be supplied, especially those of the working classes. That class, indeed, in London do not, as a rule avail themselves of the use of gas in their dwellings, and by no means to the extent they do in the northern towns of England or in Scotland. For example, in the well-to-do parishes of Marylebone and Paddington, in London, the number of inhabited houses supplied with gas are 72 and 80 per cent. respectively of the whole number, whilst in Bethnal Green 27 per cent. only of the dwellings are thus supplied, and in the northern towns of England, as well as in Scotland, the number of one-light meters, which are essentially the poor man's meters, greatly exceed those used in London. Very few of the small dwellings in London indeed have any gas-fittings in them, the poor for the most part still use the common dip candle; or a paraffin lamp, when some manufacture is carried on which requires an extra amount of light; and yet it will be seen from a very interesting table annexed that, adopting the common standard of a sperm candle for comparison, the quality of gas now sold in London at 3s. 9d. per 1000 cubic feet, will give 52 hours of light for 1d., whilst dip candles at 6d. per pound will give only 5 hours and 45 minutes of the same light for that money.

Comparative Cost of Illumination by Different Lighting Materials in Common Use, showing the Hour of Duration for each Penny. The Light Reduced to Equal One Standard Sperm Candle.

Description of Material.	Price in London. s.	d.	Hrs. Light for 1d. h.	m.
Standard sperm candle, per lb....	2	0	2	15
Best wax candle, per lb.....	2	0	2	15
Sperm oil in moderator, per gal...	9	6	2	24
Belmont sperm oil, per lb.....	1	3	2	54
Stella or Burmese wax, per lb.....	1	3	3	15
Petroline candles, per lb.....	1	6	4	30
Composite candles, No. 1, per lb.	0	11	4	10
" " No. 3, "	0	8	5	30
Common dip candles, per lb.....	0	6	5	45
Almond oil in moderator, per gal.	9	3	6	00
Colza, per gal.....	5	0	9	15
Paraffin oil lamp, per gal.....	3	0	19	11
Common gas, per 1000 feet.....	3	9	52	0

NOTE.—The writer states that he is indebted for the above table to Mr. George Glover, of the Ranelagh Works, Pimlico, the manufacturer of the celebrated dry meter, the experiments for which table were made under Mr. Glover's personal superintendence.

The working classes of London, therefore, require to be educated in this particular, among other things relating to the economy of living, and it is satisfactory to notice that in the new dwellings for artisans, and in some of the model lodging-houses lately erected, the promoters of those excellent institutions are doing their best to this end by fitting the several rooms with the needful appliances, so that the occupiers may avail themselves of the cheapest mode of obtaining artificial light.

Testing Portland Cement.—Three tests are used: 1. Resistance to the tensile force. 2. Specific gravity. 3. Water-test The first is by making a specimen briquette in a mold with a transverse section of 2.25 square inches, the specimen being held vertically in clips, which is placed under the short arm of a steel yard balance, and broken. Mr. Bazalgette used a test of 500 lbs. on an area of 2.25 square inches after 7 days immersion in water. The second method is by finding the weight in pounds of the struck bushel. The water test is useful when the others cannot be applied. It consists of gauging a small quantity of the dry powder with water, and immediately immersing it in water. If the sharpened edges crack or break away after a short time, the cement is too hot or fresh, or is inferior in quality. The weight of good Portland cement ranges from 100 lbs. to 130 lbs. per bushel, equal from eighty pounds to 130 pounds per cubic foot. The lighter kinds set more rapidly than the heavier, but are weaker. Mr. Bazalgette specified a specific gravity of 110 lbs. to the bushel.

Preliminary Notice on the Action of Sulphuric Acid on Naphthaline.

By JOHN STENHOUSE, LL.D., F.R.S., &c., and CHARLES E. GROVES.

Faraday,* many years ago, observed that when naphthaline was heated with concentrated sulphuric acid, a mixture of two sulphonic acids was formed. These acids yielded baryta salts, which differed from one another in that one of them burned with flame when heated, whilst the other merely smoldered. Mertz and Weith, who have carefully examined these acids,† found that when sulphuric acid (400 grms.) was heated with excess of naphthaline (500 grms.), at 160°, for eight hours, the product, besides "*unaltered naphthaline*," consists almost entirely of B-naphthaline sulphonic acid, with traces of the a-sulphonic acid and of the disulphonic acid. On examining what these chemists believed to be "unaltered naphthaline," however, we found that it contained a comparatively large quantity of sulphur compounds insoluble in water, and from which, after a few preliminary trials, we succeeded in isolating three distinct crystalline compounds.

In order to obtain satisfactory results, and to facilitate the subsequent purification of the compounds, it is necessary to employ pure naphthaline. This may be obtained by heating the purest commercial naphthaline, with a small percentage of sulphuric acid, to about 180°, for some hours, and distilling the resulting black mass in a current of steam; repeating the process until the hydrocarbon will dissolve at 100°, in an excess of concentrated sulphuric acid, without the slightest tinge of color. A mixture of 8 parts of the hydrocarbon with 3 of sulphuric acid are then heated to 180° in a large retort; after the lapse of two or three hours, water begins to come off, and the mercury in the thermometer fall, so that it is necessary to increase the heat in order to maintain the temperature constant. At this stage a reaction appears to set in which continues for an hour or two, accompanied by the elimation of a considerable quantity of water, which distils over. About an hour after water ceases to come over, the source of heat is withdrawn, and the retort and its contents allowed to cool to 100°: 4 parts of boiling water are then added, and the mixture poured out into a basin or other convenient vessel. On examining the product when cold, it will be found to consist of two layers; the lower one being a dirty greenish, pasty, mass of crystals, of the nearly pure B-sulphonic acid; whilst the upper solid cake, which is of a pale brownish yellow color, consists of the new sulphur compounds mixed with excess of naphthaline. The solid cake is separated from the crystals of acid, and submitted to distillation in a current of steam in the usual way: the naphthaline then passes off with the aqueous vapor, leaving a brown oily layer at the bottom of the water in the distilling flask, which oil, however, becomes solid on cooling.

Naphthaline Sulphones.—The most convenient way of obtaining the sulphones in the crystalline state from this cake is to powder it and boil it up with carbon bisulphide, filtering hot, and washing the undissolved portion with carbon bisulphide until the washings pass through colorless. The solution, if sufficiently concentrated, when allowed to stand, deposits a considerable quantity of hard, thick, prismatic crystals of *a-naphthaline sulphone*, mixed, however, with nodular masses of needles, from which they may be separated mechanically or by repeated fractional crystallisation from alcohol and from carbon bisulphide. The a-sulphone may very readily be purified by alternate crystallisation from these solvents, and it then melts at 123° C. When submitted to analysis it gave numbers corresponding closely with those required by the formula $C_{20}H_{14}SO_2$. It is colorless and insoluble in water, but moderately soluble in boiling alcohol, from which it crystallises out in great part, on cooling, in opaque nodules and transparent plates. It is also moderately soluble in ether

* *Phil. Trans.*, 1826 140.

† *Dent. Chem. Ges. Ber.*, iii., 195, and *Zeits. Chem.*, vi., 169.

and in hot carbon bisulphide, crystallising from the latter in compact, transparent, oblique prisms. It is easily soluble in hot benzene or glacial acetic acid, but only very slightly soluble in petroleum. Hot concentrated sulphuric acid dissolves it, apparently forming a sulphonic acid, whilst with nitric acid the sulphone yields, a readily-fusible nitro-derative, which may be obtained in a crystalline state from hot alcohol. Although the sulphone is not acted on by potassium dichromate and dilute sulphuric acid, a solution of chromic anhydride in glacial acetic acid readily oxidises it. On adding water to the solution a pale yellow substance is precipitated, which is easily soluble in alcohol.

The portion left undissolved, when the crude substance is treated with carbon bisulphide, consists almost entirely of B-naphthaline sulphone, and may readily be purified by a few crystallisations from alcohol, although it is somewhat difficult to obtain it free from all trace of color. The tufts of needles which crystallise out of the corbon bisulphide solution along with the *a*-sulphone, also consist of C-naphthaline sulphone. When pure it crystallises from boiling alcohol, in which it is but slightly soluble, in colorless silky needles. It melts at 177°C., and the results of the analyses that were made showed it to be isomeric with *a* naphthaline sulphone. Like that substance. therefore, it has the formula $C_{20}H_{14}SO_2$. The B-sulphone is insoluble in water, very slightly soluble in petroleum, carbon bisulphide, or cold benzene, although it is tolerably soluble in hot benzene and glacial acetic acid. It dissolves in hot concentrated sulphuric acid, forming a sulphonic acid, and when gently heated with nitric acid, sp. gr. 1·45, it first fuses to an orange-brown oily layer, which then rapidly dissolves in the hot acid. If the solution be now allowed to cool, most of the nitro-derative is deposited as an oil, which solidifies after a time; but if the hot acid solution is diluted with nitric acid, of sp. gr. 1·35, boiled for a minute or two, and set aside to cool, the new compound is deposited in microscopic crystals. These are only very slightly soluble, either in alcohol, glacial acetic acids, or benzene. It yields an amido-compound when treated with tin and hydrocholoric acid. The B-sulphone, like its isomeride, is not attacked by potassium dichromate and dilute sulphuric acid, although chromic anhydride and glacial acetic acid readily oxidise it; the addition of water then precipitaes a pale yellow body, easily soluble in alcohol.

It was pointed out by one of us some years ago* that phenyl sulphide, $C_{12}H_{10}S$, when treated with oxidising agents, was readily converted into benzene sulphone, $C_{12}H_{10}SO_2$. It seemed of interest to ascertain whether naphthyl sulphide, $C_{20}H_{14}S$, would behave in a similar manner. For this purpose some *a*-naphthyl sulphide, kindly placed at our disposal by Dr. H. E. Armstrong, was treated with potassium dichromate and dilute sulphuric acid; the compound was rapidly oxidised, but the product was resinous, and resisted all our efforts to obtain from it any crystalline compound resembling the sulphones above described.

We hope soon to be able to give further details with regard to the properties and reactions of the various compounds mentioned in this paper, and also to describe the other crystalline substance which accompanies the sulphones, but difiers from them in being exceedingly soluble in carbon bisulphide.—*Chemical News.*

The relative strength of various substances is stated as follows in the *Scientific American*: A rod ¼ inch in diameter, of the best steel, will sustain, before breaking, 9,000 lbs; soft steel, 7,000 lbs.; iron wire, 6,000 lbs.; good iron, 4,000 lbs; inferior bar-iron, 2,000 lbs.; cast-iron, 1,000 to 2,000 lbs.; copper wire, 3,000 lbs.; silver, 2,000 lbs.; gold, 2,500 lbs.; tin, 300 lbs.; cast-zinc, 160 lbs.; cast-lead, 50 lbs.; milled lead, 200 lbs.; box or locust wood, 1,200 lbs.; toughest ash, 1,000 lbs.; elm, 800 lbs.; beech, cedar, white-oak, pitch-pine, 600 lbs; chestnut and maple, 650 lbs.; poplar, 400 lbs.—*Popular Science Monthly.*

*Proc. Roy. Soc., xiv., 384.

Gas-Light Intelligence.

United States.

Fatal Gas Explosion at the Capitol.—John King killed and S. B. Cutler severely injured.—A gas explosion occurred at the Capitol about half-past 3 o'clock yesterday afternoon in a small room used for storing documents under the east stairway of the Senate near the restaurant, by which Mr. John King, head carpenter, under the Supervising Architect, was so severely injured that his death resulted a little after 7 o'clock p. m., and S. B. Cutler, assistant superintendent of the document folding room, was severely injured. The concussion was distinctly felt throughout the entire building, The halls on the south side were filled with smoke and stifling gases, and it was with considerable difficulty that the scene of the explosion could be reached. Carpenters had been employed for some days past placing shelves in the room for the purpose of storing there a lot of books from the folding room. The only opening to this room, where the explosion occurred, was the door leading into it.

There was a bracket gas light over the door, and some of the employees on leaving the room must, in turning off the gas, have turned it on again without knowing it, there being no check on the key, which, on account of its height from the floor, was usually turned with a stick. The room was thus filled with the escaped gas. In the afternoon Captain Cutler with Mr. King went the to room to see after the shelving. Mr. King, unlocking the door, entered the room, followed by Captain Cuttler a few feet behind. The room being very dark, they both stepped back towards the door, as the smell of gas was oppressive. When Mr. King reached the door he struck a match, and instantly a tremendous explosion occurred, both being thrown with great force against the wall on the opposite side of the hall.

Mr. King was forced against the door jam, which fractured both his knees, and pieces of the door and sash, which were blown off, cut his face and neck in a frightful manner. He was also shockingly burned about head and arms. When found he was doubled up on the floor of the hall, his head and breast having fallen forward upon his legs. A gash was found extending half way from the nose to the ear over the right eyebrow, the right thigh broken and the bone protruding through the flesh. At first he was supposed to be dead, but finally was seen to gasp, when restoratives were applied by some physicians present, and he was removed at once to Providence hospital.

Captain Cutler was stunned, and presented a frightful appearance with his face, neck and hands blistered, hair and whiskers singed close to the skin, but no bones were broken. He was taken into the room of the Sergeant-at-Arms, suffering great pain, and Senators Withers and Bennis, both belonging to the medprofession, attended him, and after his wounds were dressed he was removed to his home. Dr. McCoy, who is attending him, reports him badly burned, but that he has no external injuries, and, if erysipelas does not set in, will recover.

Mr. King was attended on his his arrival at Providence Hospital by Drs. J. E. Brackett and Beall, who dressed his wounds and, after administering opiates, made a more extended examination of his injuries and decided that nothing could be done to save his life, as the concussion had done its work. He lingered till afttr 7 o'clock, when death relieved him of his sufferings. Mr. King was abont fifty years old, of good raputation for integrity, and he leaves a family who reside on 6th, between H and I streets, northwest.

The door to the room was torn from its hinges and dashed against the opposite wall, shivering it to pieces. The wall was disfigured and torn, and in one place is to be seen the prints of Mr. King's hand, with portions of the blistered skin still clinging to the hard finish. The walls are blistered and blackened by the heat, and such was the force of concussion that after turning two angles, at least forty or fifty feet from where it occurred, the transom at the head of the Senate stairs was dashed into the room of the official reporters of the Senate, causing no little consternation among that diligent corps. The doors of the Senate restaurant were slammed to and fro, and a hat rack standing in a second room against double doors broken to pieces. The cashier of the restaurant was thrown violently back against the wall.—*Washington Evening Star.*

Great Britain.

An apparrtus for the manufacture and utillization of combustible gases has been patented in England. In this invention bituminous coal is placed in a retort and subjected to distillation. The rich hydrocarbons are eliminated therefrom in the form of gas, but when the stage of distillation is reached at which the sulphurous and phosphoreted gases are disengaged from the coal, the gaseous products of the retort are diverted from the previous and purer product, and are passed into water or carried to the furnace, in order to aid by their combustion the heating of the retort. The result is a comparatively pure hydrocarbon gas and a coke practically free from sulphur, phosphorus, etc. From the gasometer the gas is passed to a retort filled with broken fire-brick, as the hydrogen is separated from the carbon it assumes the volume peculiar to the gas.—*Coal Trade Journal.*

Chemical and Scientific Repertory.

Cement for Broken China.—Make a thick solution of gum arabic in water, then stir in plaster of Paris until the mixture becomes a sticky paste. Apply with a brush to the broken edges, stick them together, and in three days the article cannot be broken in the same place.

Apparatus for Moulding Fuel.—A patent has been granted in Great Britain for an apparatus for the moulding of fuel, making it more compact for storage, preventing spontaneous combustion, and helping the burning. This invention consists in moulding blocks of artificial fuel of such a geometrical form as that they will pack closely together on all sides, and not leave any vacant spaces whereby less room is required in storing, and the spontaneous combustion of ships cargoes of fuel is prevented.—*Coal Trade Journal.*

Pumping Machinery.—Most of the pumping machinery employed in the drainage of the underlying sections of Holland has been made in England, and the English manufacturers have had a practical monopoly of the business of filling these orders for many years. They are now feeling American competition in this line. The Fitchburg, Mass., Steam Engine Company have just shipped their eighth engine to Amsterdam, and the first was sent as an experiment less than six months since. This is one of those apparent anomalies of commerce that are only shown to be both possible and profitable by attempt and perseverance. If American machine works can now build up business with an old and wealthy country like Holland, and increase it under the very nose of England, similar works can achieve equal results with other countries by the same effort. And this is the great demand of the time—an earnest effort to gain all foreign markets possible.—*Iron Age.*

Neck vs. Feet and Wrists.—Every one must remark that a favorite article of winter clothing for children is a comforter swathed round the neck. This is a great error; the feet and the wrists are the proper members to keep warm; the face and throat will harden into healthy indifference to cold; but that muffler exchanged for an extra pair of thick socks or gloves would preserve a boy or girl really warm and well. Bronchitis and sore throat have declined fifty per cent. since the absurd use of high collars and wice round neckerchiefs went out of fashion; and if

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the poor would take better care of their children's feet half the infantile mortality would disappear. It only costs a trifle to put a piece of thick felt or cork into the bottom of a boot or shoe, and the difference is often considerable between that and a doctor's bill, with, perhaps, the undertaker's beside.

NEW ELECTRIC LIGHT.—A new electric light, experimented upon some weeks ago on the rosf of the Siemens-Halske works, at Berlin, praved so successful that ordinary writing could be read at the distance of a mile. When the light was thrown toward clouds by means of a mirror a luminous train appeared thereon, which much resembled the tail of a comet, and drew together great crowds of spectators in the streets. Signals made by the instrument were also repeated upon the clouds, becoming thus visible at a very great distance. The experiments were made in the presence of a large number of artillery and other branches of the government service, and were continued for nearly two hours. The instrument, which is provided with a locomotive engine, will be set up in the Tegel arillery polygon for further experiment, the German war department having the intention of purchasing several of the machines for military use, both afloat and ashore.—*Revue Militaire d'Etranger.*

A curious exhibition has just been organized at the Simonetti Palace, on the Corso, in Rome. It is a display of asbestos in all the stages through which it passes from the time it is taken out of the bowels of the earth until it appears as a manufactuaed article. Asbestos is a compound of sillicate of magnesia, and has the property of resisting fire. The ancients had discovered a means of weaving it, and with it made napkins for meals, wicks for lamps, and winding sheets for the dead for purposes of cremation, so that the ashes of the deceased could be collected unmixed with those of the wood which had formed the funeral pyre. The process of working this textile has been again discovered by the Marquis de Batrera, as well as the merns of making with it incombustible paper and cardboard at a low price.—*Coal Trade Journal.*

AN AUTOMATIC LIGHT-REGISTERING MACHINE.—Mr. Crookes has made an ingenious application of his radiometer to meteorological purposes. In our present meteorological records we note variations in heat, rainfall, atmospheric pressure, etc., but light, the most important influence, has been neglected hitherto, for the want of a machine for automatically registering its variations. Mr. Crookes has arranged the arms of his radiometer so that they carry round a small magnet suspended beneath them. The amount af light falling on the pith-balls at the extremities of the radiometer arms determines the rate of rotation. Near the magnet, attached to the rotating arms, is suspended another magnet, which oscillates as rhe attached magnet presents alternately its north and south poles. This oscillation makes and breaks an electric circuit, which, by a wire of any required length, is connected with a recording Morse machine moved by clockwork. Each revolution of the rotating pith-balls is thus recorded by a punch of the Morse on a strip of paper, and so a register is kept of the amount of light falling at any place.—*Popular Science Monthly.*

A Wonderful Discovery.

REVELATION OF THE PROCESS OF THE FORMATION OF ANTHRACITE COAL.

We have before us now on our table a specimen which is one-half anthracite coal and the other half a solidified sediment that four years ago was all soft sediment. For over four years there has has been in use in the Indian Ridge shaft of the Philadelphia Coal and Iron Company, this district, a wooden pipe, about six inches in diameter, made of inch boards nailed together, which served to carry water from one of the rings in the shaft to the lower level. The rings are boxes around the sides of the shafts which catch the water coming out of the rock, slate, or coal, and are put in to prevent the water from falling down and making a regular shower bath of the shaft. At the rink in question a large spring in the slate, about thirty feet below the primrose vein, had been struck, the water from which is apparently as pure as crystal.

Some four months since it was found that this wooden pipe had become so clogged with the reddish brown sediment that is deposited by all mine water, that the open space in it was not more than two inches in diameter, and not large enough to carry off the water from the ring. Consequently a new pipe was put in, and the old one, nearly closed with the sediment adhering to its sides, was left standing. The water was then turned into the new pipe and cut off from the old one, which is some fifty feet or over in length. On Friday last, after remaining in the shaft without any water passing through it for over four months, the greater part of this old pipe was taken out, and when broken open the wonderful phenomenon presented itself that the sediment was gradually changing into what appeared to be anthracite coal. About a half inch of the inside of the sediment lining the pipe had changed into coal, and the remainder was also gradually changing, the only portions of the sediment remaining quite soft, being that part deposited first and next the sides of the pipe. A cross section of the pipe now shows, commencing at the centre, first a circle of about half an inch in diameter surrounding the two-inch opening remaining in the pipe, then a circle of sediment partly turned into coal, and then the sediment in its natural state and the sides of the pipe. The surface of sediment which was exposed to the action of the atmos phere has changed first, and the influence or chemical combinations which had changed its nature were gradually operating on the rest of the sediment. The process of formation is plainly seen in the sediment next that already turned into coal.

Samples of coal taken from the pipe have been tried on the blacksmith fire at the colliery, and it makes an exceedingly hot fire, but being of a softer nature than the natural anthracite, it clinkers badly. Fortunately there are any quantity of samples of this wonderful formation, and those who are unwilling to believe without themselve seeing and touching, can be accommodated. There is no Keely-motor business about this discovery. A section of the pipe about 16 feet long has been left standing in the shaft, to see what results will follow in the next six months or year. Samples have also been sent to Gen. Pleasants at Pottsville for examination, and we suppose the public will soon have the opinion of gentlemen qualified to judge on this surprising formation; but if anthracite coal will form from sediment deposited by mine water when exposed to the action of the atmosphere under certain conditions for a period as short as four months, what becomes of all the pet theories of the geologists and mining engineers on the subject? How about the great heat, the millions of years of time, and tremenduous pressure which, according to the various theories of the heretofore-accepted authorities, were necessary to account for our deposits of the finest and best fuel yet found?—*Shenandoah Herald.*

Explosive Character of Acetylene Copper.—The explosive character of acetylene copper is well known. Many serious accidents have occurred from its presence—spontaneously formed—on copper pipes employed for conveying illuminating gas. Such accidents have resulted from slight blows with a hammer or some other iron tool given by workmen when engaged in making repairs, etc. According to the *Polytechnisches Notizblatt*, another copper compound has recently been prepared, which, when mixed with chlorate of potash, forms an explosive, which it is proposed to use for filling percussion caps, torpedoes, etc. The mode of producing this compound or salts of copper is as follows; To a solution of sulphate of copper is added enough hyposulphite of soda, in solution, to entirely destroy the blue color. To another portion of the blue vitriol solution ammonia is added, until the blue precipitate, at first formed, dissolves to a dark blue solution. The two solutions are now mixed; and after long standing a violet colored salt crystallizes out of the beautiful blue liquor. It is this salt which becomes explosive when mixed with chlorate of potash. The composition of the "violet colored salt," above referred to, and which constitutes the new explosive, is not given by the authority quoted; neither is any reference made to the probable cause of its explosive nature. It may possibly be due to the nitrogen imparted to it by the ammonia.—*Scientific Press.*

Conductibility of Gases.—M. A. Winkelmann has measured the conductibility of gases for heat by an apparatus like that of Stephan, except that a peculiar manometer and method of closure is used. The apparatus consists of a brass cylinder serving as an air thermometer enclosed in a second concentric cylinder. The top of the inner cylinder may be unscrewed and it carries a conical cavity in which is placed a rubber cork with a hole through it. A glass tube passes through this hole and a metallic cap screwed on below the rubber presses it against the glass. A similar closure carries the tube through the outer cylinder. The latter is connected with a mercury pump. A comparison of the time and variations of the pressure when the outer cylinder was immersed in ice-water gave the following coefficients of conductibility:

Name.	Conduct.
Air	·0600525
Hydrogen	·0003324
Carbonic Acid	·0000317
Ethyl	·0000414
Marsh Gas	·0000647
Nitric Oxide	·0000460
Carbonic Oxide	·0000510
Oxygen	·0000563
Nitrous Oxide	·0000363
Nitrogen	·0000524

—*Pogg. Ann.* clvi, 497.

Price of Gas.

The following prices are *official*, having been furnished to the AMERICAN GAS-LIGHT JOURNAL by the officers of the various Gas Companies.

Albany (Peoples) N. Y.	$2.75	
Annapolis, Md.	3.40	
Atchison, Kansas.	4.50	
Austin, Texas.	6.00	
Allegheny City, Pa.	1.80	20 p. ct. off prompt pay
Albany, N. Y.	2.75	

Ashland, Ohio	3.50	Street lamps 4½ hours 17 nights per month, $15 per annum.
Augusta, Ga	4.00	Net.
Anderson, Ind	3.50	Crude petroleum.
Ashtabula, Ohio	2.00	Wren's process; $10 for 80 candle gas.
Auburn, N Y	3.50	5 p c off prompt pay.
Allentown, Pa	2.50	$18 per an street lamps Meter rent 10 cents per month.
Ashland, Pa	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Brooklyn, B'klyn	2.75	
" Citizens	2.75	
" Nassau	2.75	
" Metropol'an	2.75	
" Peoples	2.75	
" W'msburgh	2.75	
Brockton, Mass	3.80	
Batavia, N: Y	3.00	
Bridgton, N. J	3.50	
Bangor, Me	3.00	
Boonville, Mo	4.50	
Brownsville, Tenn	4.50	
Belfast, Maine	4.00	10 p. c. off bills over $10; 5 p. c. off bills under $10.
Brockville, Ontario	3.75	
Bloomfield, N J	3.75	
Belleville, Ill	3.50	
Bellaire, Ohio	2.85	5 p ct. off prompt pay.
Barnesville, Ohio	3.00	5 p ct. off prompt pay. Street lamps $17.50 per ann. Burn till 12 P. M. on moonless nights.
Boston, Mass	2.25	
Bath, Maine	4.00	12½ p c off prompt pay.
Bayonne City, N. J	4.00	Net.
Binghampton, N. Y	4.00	10 p c off prompt pay on bills for 1000 per month.
Buffalo G L Co., N Y.	2.50	10 p c off prompt pay.
Buffalo Mutual, N Y	2.50	10 p c off prompt pay.
Buffalo Citizens, N Y.	2.50	10 p c off prompt pay.
Bloomsburg, Pa	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Cleveland, Peoples, O	2.00	
Cumberland, Md	3.00	
Charleston, W. Va	4.00	25 p. ct. off prompt pay Meter rent 25, 30, and 50 cents. per m. for 3, 5 and 10 light.
Cincinnati, Ohio	2.25	
Columbia, Mo	4.50	
Carondolet, South St. Louis, Mo	3.00	5 p. ct. off prompt pay,
Chattanooga, Tenn	3.00	
Cold Water, Mich	3.25	
Chicago, Ill	2.50	
Columbia, Pa	2.85	Lowe process.
Charlottesville, Va	3.50	Meter rent 20 cents.
Cedar Rapids, Iowa	4.50	50 cts p M. off prompt pay.
Cairo, Ill	3.75	50 cts added if not paid by the 5th.
Cortland, N. Y	4.00	25 cts p M. off prompt pay.
Cairo, Ill	3.75	50 cents per month off prompt pay. For 20,000 feet a month $2.50.
Chillicothe, Ohio	3.00	
Camden, N. J	3.16	5 p c off prompt pay; 10 p c off for 100,000 per year.
Carson City, Nevada	8.00	Gas from wood and Cannel coal.
Cadiz, Ohio	3.50	10 p c off on 500 feet or less; 50 cts per M. on from 500 to 2000; 20 p c off on 2000 and upwards.
Derby, Conn	3.60	10 p. c. off prompt pay, and 50 cts per M. on excess of 5000 ft. per month.
Decatur, Ill	3.50	50 cts. per M. added, if not paid by 10th.
Danbury, Conn	4.28	For less than 5000 per month.
" "	3.85	For over 5000 per m th
Dover, Del	3.60	
Dunkirk, N Y	2.50	Street lamps till 12, moonless nights $25 per annum.
Defiance, Ohio	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
East Boston, Mass	3.00	
East St. Louis, Ill	3.50	5 p. c. off prompt pay.
Evansville, Ind	3.00	City lamps $30.
Erie, Pa	3.00	City lamps $28 p. an.
Elkhart, Ind	3.50	
East Newark, N. J	4 00	
Eastchester, N. Y	3.50	
Elizabethtown, N. J	3.00	
E ast N Y (Union) L I	3.00	
Eastport, Me	4.00	
Fredericksburg, Va	3.40	
Flint, Mich	3.50	
Franklin, Pa	3.00	
Fall River, Mass	3.00	
Freeport, Ill	3.80	
Fort Scott, Kansas	4.50	
Flatbush, L. I	3.50	
Fredonia, N. Y	3.00	Street lamps $25 per annum; burn fill 12 P. M.
Guelph, Ontario	3,50	
Geneva, N, Y	2.50	5 p. c. off prompt pay. Wood and oil gas.
Greensboro, N. C	4.00	
Galena, Ill	4.50	Meter rent 25 cts. per month.
" "	4.00	After September 1st.
Grand Rapiids, Mch	2.80	For less than 1000 feet per month.
" " "	2.50	For over 1000 eet per month. 10 per ct discount on 300,000 ft annually
Gloucester, N. J	3.15	5 p c off prompt pay.
Greenwich, Conn	2.40	Wren's process
Goshen, Ind	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Huntsville, Ala	3.50	
Hempstead, L. I	4.00	
Huntingdon, Pa	3.80	10 per ct. off prompt pay.
Hagerstown, Md	3.75	
Hamilton, Ohio	4.00	
Hillsdale, Mich	3.50	
Holyoke, Mass	3.01	
Hartford, Conn	2.75	
Hornellsville, N. Y	3.50	50 cents per 1000 off prompt pay.
Honesdale, Pa	4.00	12½ cents meter rent per month.
Ithaca, N. Y	4.00	5 p. c. off prompt pay.
Indianapolis, Ind	2.50	
Indiana, Pa	3.00	10 p. c. off prom pay Meter rent 50 cents per month.
Jersey City, N. J	2.75	
Joliet, Ill	3.50	
Jacksonville, Ill	4.00	12½ p.c. off prompt pay.
Jefferson City, New Orleans, La	4.00	
Johnstown, N Y	3.50	
Knoxville, Tenn	3.00	Meter rent 15 cents.
Lyons, N. Y	4.00	
Lima, Ohio	3.80	
Lynchburgh, Va	3.00	5 p. ct. added to bills not paid in 5 days.
Louisiana, Mo	4.50	
La Crosse, Wis	4.50	50 cents per M. off prompt pay.
Lancaster, Pa	3.00	
Louisville, Ky	2.70	5 p. c. off prompt pay.
La Porte, Ind	3.50	Wood and oil gas.
Lowell, Mass	2.50	25 cents per 1000 off prompt pay.
Lafayette, Ind	2.75	
Lexington, Mass	2-40	Wren's process.
Millville, N. J	3.12	
Milford, Del	3-50	
Marquette, Mich	3.50	
Morris, Ill	2.00	For 15 candle power, or $10 per M. coal gas meter measure (Petroleum Gas—Wren's patent).
Meriden, Conn	3.93	
Marietta, Ohio	3.50	20 cts. per M. off if paid by 6th. Consumers over 3000 ft. 30 cts. additional discount.
Marshalltown, Iowa	4.50	50 cts p M. off prompt pay.
Meadville, Pa	3.50	25 cts p M. off prompt pay.
" "	2.50	For over 10,000 ft. per month,
Madison, Ind	3.75	25 p c off if paid in five days: 25 to 40 cents per month meter rent.
Monroe, Mich	3.50	5 per ct off prompt pay
Malone, N. Y	4.50	
Middletown, Conn	3.56	Net.
Mount Sterling, Ky	4.50	
Monongahela, Pa	2.75	Under 5000 feet m'th $2.75 per M.; over 5000 feet per month $2.50 per M.
Minneapolis, Minn	5.00	10 p c off prompt pay.
Mahanoy City, Pa	10.00	70 candle; 20 p c off prompt pay. Patton's process.
Morristown, Pa	3.00	18 candle coal, and oil.
New York, New York.	2.50	
" " Harlem	2.75	
" " Manhattan	2.50	
" " Mutual	2.50	
" " Mropolitan	2.50	
" " Municipal.	2.50	Water Gas.
Nashville, Tenn	2.85	
Newark, Citizens, N.J.	2.85	
Norfolk, Va	3.10	
New Brunswick, N. J.	2.70	
Newton, N. J	4.00	
North Attleboro, Mass.	3.50	
New Britain, Conn	3.70	
New Haven, Conn	2.75	
Nantucket, Mass	3.00	Meter rent 15 cts. p. m.
Newark, N. J	2.85	
Niagara Falls, N. Y	3.50	20 cts p M. off prompt pay.
Norwalk, Cenn.	4.00	12½ p ct off prompt pay.
New Albany, Ind	3.00	
New City, Montreal	2.50	Street lamps, $22 p an
Oswego N. Y	3.15	5 p. c. off prompt pay.
Ottawa,, Ill	4.00	12½ p. c. off promptpay
Omaha, Nebraska	5.00	
P'keepsie, Citizens	2.70	Gwynne Harris process
Paterson, N. J	3.80	10 p c. off prompt pay, and in addition 5 p.c. on bills of $200; 10 p. c. on bills of $1000
Portchester, N. Y	3.50	
Pittsfield, Mass	3.50	5 p. c. off prompt pay, and 10 p. c. off on bills of $350 per an.
Portland, Me	3.00	
Paris, Ky	4.50	Meter rent 25 cts. p m.
Portsmouth, N. H	3.22	
Pittsburgh, Pa	1.00	
Philadelphia, Pa	2.15	
Painesville, Ohio	3.50	
Pawtucket, R. I	3.00	Over a million feet a year $2.70.
Providence, R. I	2.25	
Pottsville, Pa	3.50	10 p ct off prompt pay.
Plainfield, N. J	3.50	5 p ct off for less than 5000 a month. 10 per cent more than 5000 a month.
Peoria, Ill	3.50	
Paducah, Ky	4.00	10 p c off prompt pay.
Plymouth, Pa	10.00	70 candle. Patton's process.
Pottstown, Pa	3.20	Public lamps till 11 P. M., 18 nights per month $20 per lamp.
Poughkeepsie, N Y	2.60	10 p c off prompt pay.
Port Huron, Mich	3.50	
Quincy, Citizens, Mass.	5.00	
Quincy, Ill	3.50	
Quebec, Ont	2.40	
Rome, N. Y	3.60	
Rochester, N. Y	3.00	
" Citizens	3.00	
Rondout, N. Y	3.60	
Rockford, Ill	4.00	5 p c off prompt pay; 10 to 25 p c off on bills for 500 to 25 M, feet per month.
Richmond, Ind	3.00	50 cents added if not paid by 20th.
Syracuse, N. Y	2.75	
Springfield, Ill	3.25	$25 for city lamps.
St. Joseph, Mo	4.00	12½ p. ct. off on bills over $100 p. month.
St. Albans, Vt	5.00	10 p. c. off prompt pay, and in addition 5 p. c. off bills from $50 to $100 per month; 10 per. ct. off bills over $100.
Sandusky, Ohio	3.00	
Saratoga, N. Y	5.00	20 p. c. off prompt pay, Nov. 1st to May 1st. 10 p. c. rest of year.
San Antonio, Texas	7.00	10 per ct off from 10 to 20,000 per month 20 p ct off from 20,000 and upwards.
St. Charles, Mo	4.50	
Sidney, Ohio	3.25	
Steubenville, Ohio	2.50	
Sherman, Texas	5.00	5, 10, 15 and 20 p. c. off, according to quantity.

Salem, Oregon	7.00	October last reduced from $8.
Salem, Ohio	2.75	Meter rent 12½ cts if 300 feet is not used monthly
Sedalia, Mo	3.50	
Sharon, Pa	3.15	5 per ct off on less than 5000 feet per month. 10 p ct from 5 to 15 M. 15 p ct from 15 to 20 M. 20 per ct over 40 M.
Shreveport, La	5.00	
Shelbyville, Ind	2.00	Wren's process; $10 for 80 candle gas.
Shenandoah, Pa	10·00	70 candle. Patton's process.
Shamokin, Pa	10.00	70 candle. Patton's process.
Sunbury, Pa	10.00	70 candle. Patton's process.
Tiffin, Ohio	3.00	
Titusville, Pa	3.00	
Tidioute, Pa	2.00	Wren's process.
Vicksburgh, Miss	4.50	
Wilkesbarre, Pa	3.50	10 p. c. off prompt pay.
Worcester, Mass	3.00	5 p. c. off on $500, and 10 p. c. off on $1000 in six months.
Westfield, N. Y	4.00	10 p. c. off prompt pay.
Washington, D. C	2.25	
Watertown, N. Y	4.50	10 p. c. off prompt pay.
Wheeling, West Va	2.25	10 p ct off prompt pay.
Washington, Pa	2.50	
Woburn, Mass	3.00	
Waterbury, Conn	3.50	5 p c off on bills of $50 10 p c off on bills of $100. 5 p c added if not paid by 10th.
York, Pa	3.00	Meter rent 12½ cents.
Youngstown, Ohio	2.50	10 p. c. off on bills of $50 per month.
Waterbury, Conn	3.00	5 p c off on bills of $50, 10 p c off on bills of $100; 10 p c added if not paid by 10th.
Washington, C H., O.	1.20	Wren's process; $6 for 80 candle gas.
Wilmington, Del	2.50	Street lamps 3,650 hrs per year, $31.50 per lamp.
Zanesville, Ohio	2.70	10 p. c. off on bills of $25 per month; city lamps $23.

Gas Stocks.

Quotations by W. R. Scott & Co., Bankers,

24 Pine Street, New York City.

June 2, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Harlem	$1,850,000	50	120	122
Manhattan	4,000,000	50	250	255
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	..	102	—
" Bonds..	500,000	1000	104	—
Mutual	5,000,000	100	110	112
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	135	140
Central, Westchester	466,000	50	100	105

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	190	195
Citizens	1,200,000	20	90	95
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	50	55
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	75	80
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	125	130
" Scrip		...	100	103

Out of Town Gas Companies.

Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md	2,000,000	100	165	180
" Ctfs., gold	1,000,000		105	—
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	87½	—
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	170
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	85	...
" Bonds	30,000			
Laclede, St Louis Mo	1,200,000	100	—	115
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	—	25
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	101	102
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	100	105
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	110	130
Stillwater, Minn	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Troy, Citizens	600,000	100	—	100

The coupons of the People's Gas-Light and Coke Company, of Chicago, due June 1, 1876, will be paid at the Bank of New York, National Banking Association.

A. M. Billings, Pres.

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

June 16, 1876.

DELIVERED IN NEW YORK.

English Cannel.

Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00

English Caking Coals.

Newcastle Gas	$5 50	@	00 00
Liverpool caking	11 50	@	12 00

British Province Coals.

Pictou			2 00
Block House—At Mines, $1.87, Gold			2 00
Caledonia—At Mines, $1.50, Gold			0 00
Little Glace Bay—At Mines, $1.75, Gold			0 00
Lingan—At Mines, $1.75, Gold			0 00
Sydney—Old Mine			3 00
" Reserve, $1.75, GoldMine			0 00
" International			— —

Duty, 15 cents per ton, gold. Freight to New York $2 00 currency. Cost of above coals delivered in New York, $4 75 @ $5 00, currency.)

Pennsylvania Coals.

Penn Gas Coal—At Amooy	$5 60	@	0 00
Westmoreland—At Amboy	5 60	@	0 00
Shafton	5 60	@	0 00
(In New York, the above coals $6 00)			
Youghiogheny	6 00	@	0 00
Waverly	6 00	@	0 00

West Virginia Coals.

MurphyRun	6 50	@	0 00
Despard	6 50	@	0 00
West Fairmont	6 50	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	6 50	@	0 00
Newburgh Orrel	6 50	@	0 00
Pinnickinick	6 50	@	0 00
Cloverhill of Virginia	6 00	@	6 50
McKenzie Compound Mixture			— —

American Cannel Coals.

Peytona of West Virginia	$12 50	@	00 00
Darlington of Pennsylvania			— —
Canneiton Cannel			11 00
Red Bank—at Philadelphia			6 50
" —at South Amboy			7 25

Asphalts.

Albertite of New Brunswick	$21 00	@	— 00
Trinidad Bitumen	— —	@	14 00

The Penn Gas Coal Company have contracted with the Pittsburgh Gas-Light Co. for their entire supply for the ensuing year from their Youghiogheny mines.

Within the last week contracts have been made by some of the companies in New York for about 200,000 tons of Penn Westmoreland, Waverly, Youghiogheny, and the West Virginia caking coals—at $6·00 per ton a reduction of 50 cents from last years' prices.

TO GAS-LIGHT COMPANIES.

WANTED—A SITUATION BY A PRACTICAL Man in a Gas Works. Has been fourteen years at the business in the vicinity of New York City. Is a Gas-Fitter, and can take hold of any kind of work about a Gas Works, such as making Gas, altering and repairing, piping houses, laying mains, putting up fixtures, reading meters, collecting bills, etc. The best reference. Address JOHN CLARK, 321 Division Avenue, Brooklyn, E. D., 408-2t

THE SUBSCRIBER WOULD LIKE A SITUATION AS FOREMAN, or would take charge of a small Gas Works. Address S. H. DOUGLASS, New Haven, Conn., Gas Works. 403-tf

TO GAS COMPANIES, AND CITY GOVERNMENTS.

DYOTT'S PATENT CHAMPION STREET LAMP

Doubles the Light with the same quantity of Gas used in other Lanterns. *All others* waste half their light, illuminating the sky, or if the top is of metal, absorb it.

Single Top Glass Lamps both Globular and Square become heated if a good light is put in them, and rain, hail or snow falling upon the heated glass breaks it. When one glass is broken the wind will either blow the flame against the others and break them, or destroy the entire Lamp. *Nine-tenths of the breakage and cost of repairs of other* street lamps is owing to that cause.

Dyott's "Champion" is the only double top—the only Lamp that has the Opaline White Dome, which is a *never changing reflector*; it doubles the power of, and throws the light to a greater distance. It is also a perfect *protector*, shielding the heated top or the lamp from all inclemency of the weather. The white dome is kept cool by the passage of air between it and the transparent globe below. Rain, hail or snow will never break either the globe or dome. The globe rests upon rubber cushions, and is supported laterally by elastic springs, so that contraction or expansion of the globe, or jarring of the post will not break it. They can be cleaned in one-fourth the time required to clean other lanterns. The metallic portions are of iron, copper and brass, and are the most durable, economical, efficient and cheapest lamps in existence. For public buildings, and wherever an ornamental and powerful light is required, they are made in clusters of 2, 3, 4, 6, 7 and 10 lamps, which have no equal in this or any other country for *beauty, durability, efficiency* and economy, either as to cost, use or ornamentation. Designs furnished when requested for specific purposes. Gas companies, or those who have the lighting of Cities in charge, are solicited to communicate with us in reference to the agency for its introduction.

The Franklin Institute has awarded our Champion Lamp the highest premium: (they give a silver medal) and its Committee on Science and the Arts has recommended it as the best lamp in use. It has also invariably taken the highest premium at every Exhibition at which it has been presented, and elicits the strongest commendations wherever it is used. We have several new and handsome patterns of Posts for Corporations, Parks, public and private use, also for clusters of lamps, that are not excelled in beauty or price at which they are furnished.

DYOTT MANUFACTURING CO.,
374-6meot 114 South 2nd Street, Phil'a, Pa.

GAS WORKS FOR SALE.

THE CONTROLLING INTEREST IN A small successful **COAL GAS WOEKS,** in a flourishing town in Maine. Will be sold to a practical gas maker at an extremely low price, and on very liberal terms. Address GAS MANAGER, Box 3544, Boston P. O. 408-1t

WANTED.

A COPY OF

SUGG'S GAS MANIPULATION,

Edition 1867. Address American Gas-Light Journal, stating price, etc.

JAMES MARSHALL & CO.

Franklin Foundry and Pipe Works,

MANUFACTURERS OF

GAS, WATER, AND OIL PIPES,

Works, 18th, 19th, 20th and Railroad Street.
Office, No. 23 Nineteenth Street.

Pittsburgh, Pa.

Pipes from 3-inch and upwards cast in 12 ft. lengths.

☞ Send for Circular and Price List

FOR SALE,

A HALF INTEREST IN A SMALL GAS WORKS WILL be sold, or leased to a practical gas man. Two thousand feet of natural gas per day. Address

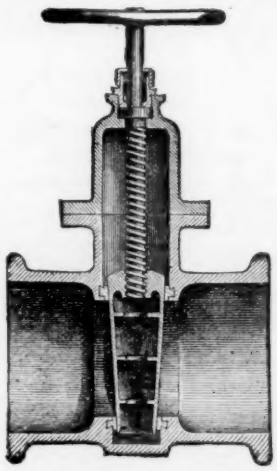
J. SHACKELTON,
405-tf Westfield, N. Y.

CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

CHAPMAN GAS VALVES.

Office and Sales Room 75 and 77 Kilby Street, Boston.



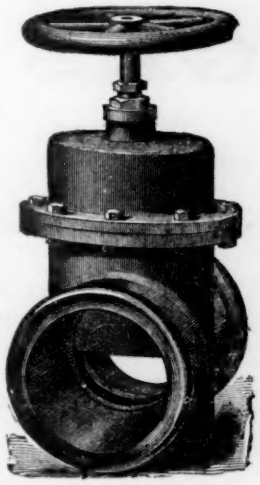
These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is no LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.

We refer to the following named Gas-Light Companies among the many that have used these Valves:



BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CAMBRIDGE GAS-LIGHT COMPANY, CAMBRIDGE, MASS.
NEWTON & WATERTOWN GAS-LIGHT CO., WATERTOWN, MASS.
LAWRENCE GAS-LIGHT COMPANY, LAWRENCE, MASS.
PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
FITCHBURG GAS-LIGHT COMPANY, FITCHBURG. MASS.
CITIZENS GAS-LIGHT COMPANY, NEWARK, N. J.
WILLIAMSBURGH GAS-LIGHT CO., WIRLIAMSBURGH. N. Y.

GAS AND WATER VALVES ½ INCH TO 36 INCHES DIAMETER.
STEAM VALVES ½ INCH TO 12 INCHES DIAMETER.

357-tf

Advertisers Index.

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American Meter Co.—West 22nd st., N. Y., Arch and 22d st., Phil., 548 Washington st., Boston.
Cast Iron Gas and Water Pipe—S. Decatur Smith, York and Moyer streets, Phila., Pa.
Cast Iron Gas and Water Pipes—R. D. Wood & Co., Philadelphia Pa.
Cast Iron Gas and Water Pipe—McNeal & Archer, Burlington, N. J.
Clay Gas Retorts, etc.—Gardner Bros., 96½ Fourth Avenue, Pittsburgh, Pa.
Cast-Iron Pipes and Fittings—B. S. Benson, 52 East Monument street, Baltimore, Md.
Cast Iron Pipes for Water and Gas—Riley A. Brick, 112 Leonard street, N. Y.
Cast Iron Gas and Water Pipe, etc.—H. R. Smith & Co., Columbus, Ohio.
Gas Valves (Chapman) 75 and 77 Kilby st., Boston, Mass.
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Gas Purification—St. John and Cartwright, 21st and Avenue A, New York.
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Gas-Light Company of America, 63 and 64 Drexel Building, New York.
Gasholders—George Stacey & Co., Ramsay st., Cincinnati, O.
Lava Tips and Scotch Tips—Charles H. Meyer & Co., 227 Chestnut street, Phil. Pa.
Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y.
Patent Gas Exhauster—Smith & Sayre, 95 Liberty sttreet.
Pelouze & Audouin Condenser—Jas. R. Smedberg, Sole Agent for U. S. San Francisco, Cal.; Henry Cartwright, 2107 Green street, Phil. Pa.
Patent Gas Exhauster—S. S. Townsend, Agt., 31 Liberty street, N. Y.

GAS COALS

Cannelton Coal Co. of West Virginia—J. Tatnall Lea 325 Chestnut street, Phila, Pa.
Cannel Chips—H. E. Hoy, 34 New street, N. Y.
Despard Coal Co.—Parmelee & Bros. Agents 32 Pine st. New York.
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New York and Cleveland Gas Coal Company—384 Fenn Avenue, Pittsburgh, Pa.
National Coal Gas Company—H. P. Allen, 4 Warren st., N.Y.
Penn Gas Coal Co.—11 Merchants' Exchange, Phil. and 90 Wall street, N. Y.
Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y.
Tyrconnell Gas Coal—52 S. Gay Street, Baltimore, Md.
Youghegheny Coal—Perkins & Job, 27 South St. N. Y.
Scotch Cannel Coals—James McKenzie, Cannel Coal Merchant, Haymarket, Edinburgh.

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Franklin Foundry and Pipe Works—Jas. Marshall & Co., 23 Nineteenth street, Pittsburgh, Pa.
Gloucester Iron Works—J. P. Michelion, Sec., 6 North 7th street, Phila., Pa.
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Oregon Iron Foundry—Herring & Floyd, 740 Greenwich street, N. Y.
Pascal Iron Works—Morris, Taskar & Co., Philadelphia.

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Clay Retort and Fire Brick Works—Edward D. White, Van Dyke street, Brooklyn, N. Y.
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Philadelphia Fire Brick Works, Vine and 23d sts., Phila,
Clay Gas Retorts, etc., etc.—J. H. Gautier & Co., cor Greene and Essex streets, Jersey City, N. J.

LAMPS, STOVES, PETROLEUM, ETC.

Lamps—M. B. Dyott, 114 South 2nd Street, Phil. Pa.
Patent Lamp Post—J. W. Graham, Chillicothe, Ohio, or A. M. Callender, office of this Journal.

MISCELLANEOUS.

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Fodell's System of Bookeeping—A. M. Callender & Co., 42 Pine st., New York.
Lowe Gas Process—S. A. Stevens & Co., Sole Agents, Room 27. Astor House, N. Y.
Gas Engineer—B. E. Cholar, 914 Olive St., St. Louis, Mo.
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Screening Shovels—A. See & Son, 1258 Broadway, N. Y.
Screening Shovels—Torrance, Merriam & Co., Troy, N. Y.
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United States Hoisting and Conveying Company, 115 Broadway, N. Y.
Wren's Gas Works—Cor. Jay and Water sts., Brooklyn, N. Y.

JOHN P. KENNEDY,

SUCCESSOR TO

Hoy, Kennedy & Co.,

GAS ENGINEER AND CONTRACTOR

For the Erection, Alteration and Extension of Gas Works.

PLANS, SPECIFICATIONS AND ESTIMATES.

Office 98 Liberty Street. P. O. Box 2,348

AGENT FOR THE

ATLANTIC DOCK

Iron & Machine Works,

FERRIS, WOLCOTT AND DYKEMAN STREETS,

South Brooklyn.

MANUFACTURERS of every kind of Gas Machinery, Retorts Bench Castings, Wrought Iron Work, Multitubular and Air Condensers, Washers, Scrubbers, Purifiers, Exhausters with every equipment complete for large or small Works, Gasholders, Telescopic or Single; Iron Roof Frames with Cornice Gutters, covered with Corrugated Iron or Slate; Iron Doors and Iron Pivot Blind Windows; Coke Barrows, Fire Tools, Retort Lids, Cotter Bars and Screws, Stop Valves, Tar Valves for Regulating Dip in Hydraulic Mains, Pressure Governors for Street Mains, and Compensators for Exhausters that are unrivalled for unvarying accuracy Steam Engines, Boilers, Etc., Etc.

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CATHELS'S

IMPROVED RETORT SETTINGS,

GUARANTEED TO HEAT UNIFORMLY WITH THE MINIMUM OF FUEL.

Colored lithograph copies of working drawings of beds of 1, 2, 3, 5, 6 and 7 retorts each, so clearly arranged and fully shown, as to be easily understood by any retort setter or bricklayer, having just been made of these valuable settings, they can now be supplied, with detailed specifications, immediately on receipt of orders.

Applications to be made to A. M. CALLENDER & CO., office of AMERICAN GAS-LIGHT JOURNAL, 42 Pine street, New York. 403

GAS COALS.

THE

PENN GAS COAL COMPANY

OFFER THEIR

COAL, CAREFULLY SCREENED,

AND PREPARED FOR

GAS PURPOSES.

Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

OFFICES

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PLACES OF SHIPMENT.

Pennsylvania Railroad, Pier No. 2 (Lower Side).
Greenwich Wharves, Delaware River.
366-1y **Pier No. 1 (Lower Side), South Amboy, N. J.**

CANNELTON COAL CO.

OF WEST VIRGINIA.

Offer for sale the following Coals, from their Colliery at CANNELTON, Kanawha County, West Virginia, delivered at RICHMOND, Va.:

CANNELTON CANNEL,

cknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 ubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

CANNELTON CAKING COAL.

Volatile Matter.	Coke.	Per cent. of Ash in		Sulphur in			Specif. Gravity.	
		Coal.	Coke.	Coke.	Oötl.	Volatile Matter.	Coal.	Gas.
35.1	64.9	2	6	.82	1.48	.66	1,289	.476

MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.. —gave 16 14-100 Candle-Power.

COKE, of very fine quality—1453 pounds produced from one ton of coal.

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SCOTCH CANNEL COALS.

THE SUBSCRIBER IS PREPARED TO CONTRACT FOR the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES McKELVIE,

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HAYMARKET, EDINBURGH.

ESTABLISHED 1840. 357-1y

WREN'S GAS WORKS.

W. C. WREN,

Corner of Jay and Water Streets,

BROOKLYN. N. Y.

HAVING GRANTED THE USE OF ONE OF my Patents to the Gas-Light Company o America, and settled my claim against them, I inform the profession that I continue to erect the Works known as

Wren's Gas Works,

and sell Licenses to use my Patents for making Gas from Petroleum.

Gentlemen of the profession:—As your consumers demand a better light, and as that demand has been in many cases sought in vain to be met by using different abortive imitations of my various processes, would it not be well to make success sure by trying the plan of the inventor.

You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method. Address as above. 397

THE NEWBURGH

Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.

Company's Office, No. 52 S. Gay Street, Baltimore, Md.

C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.

CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

SINCLAIR & AGNEW, Agents, Alexandria, Va.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

924-1y n

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y.

BANGS & HORTON, No. 31 Duane street, Boston.
Mines in Harrison County, West Virginia.
Wharves Locust Point, Company's Office, 15 German St., } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

*** Reference to them is requested 204-1y

NEW YORK AND CLEVELAND GAS COAL COM'Y

Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

YOUGHIOGHENY GAS COAL.

This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation, on most favorable terms.

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PEYTONA CANNEL COAL

From West Virginia.

Yields over 13,000 feet of Gas per ton. At ten thousand feet (standard yield) the illuminating power is over 43 candles. Purifies 4,510 feet to the bushel of lime.

S. E. LOW, Secretary,
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OFFICE OF THE

NATIONAL COAL GAS COMPANY,

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H. P. ALLEN, President.
I. B. BRICE, Vice-President.
A. H. ALLEN, Secretary.
WM. J. VALENTINE, Treasurer.
GEORGE W. HARRIS. Engineer.

This Company is the owner of the GWYNNE-HARRIS, or AMERICAN HYDROCARBON process, for making Gas for Lighting or Heating purposes, by the perfect decomposition of superheated steam, under what is known as the

GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company 348-1y

Portland Cement, Roman Cement, Keene's White Cement,

NUMBERS 1 AND 2.

From best London Manufacturers.

FOR SALE BY

S. L. MERCHANT & CO.,

76 South Street, New York,

Corner Maiden Lane. 344-1y

☞ Remit 10 cents postage for "Practical Treatise on Cement."

B. E. CHOLLAR,

GAS ENGINEER,

914 OLIVE STREET, ST. LOUIS, MO.

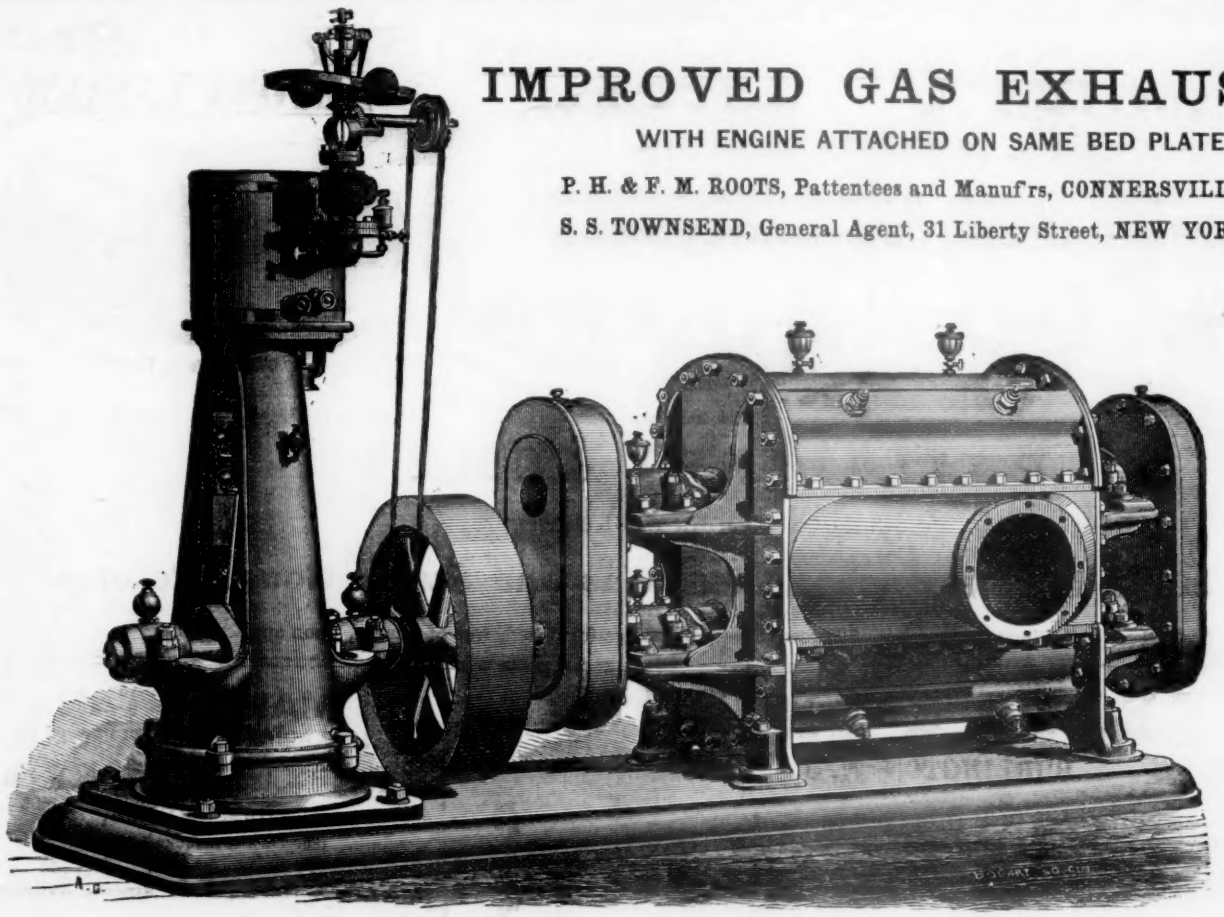
365-

IMPROVED GAS EXHAUSTER,

WITH ENGINE ATTACHED ON SAME BED PLATE.

P. H. & F. M. ROOTS, Pattentees and Manuf'rs, CONNERSVILLE, IND.

S. S. TOWNSEND, General Agent, 31 Liberty Street, NEW YORK.



ADVANTAGES CLAIMED FOR THIS EXHAUSTER.

1. It is simpler than any other Exhauster. The internal operating parts consist of only two pieces, cast entire, and can not get out of order.
2. Every part requiring care or attention, is external and easily accessible. All changes, adjustments, and repairs are made from the outside.
3. The revolvers, though practically gas-tight, do not run in actual contact, hence there is no friction, and a great saving of power effected.
4. They are built in the most complete and substantial manner, and of any required size, with steel shafts and improved journal bearings.
5. We furnish Exhausters and Engines combined on same Bed Plate, as shown above, or the Exhauster only, as may be required.
6. We also furnish Bye Passes and Gas Valves on improved plans, also Exhauster Governors and Elbows, Pipes, Drawings, etc.

Send for Illustrated Catalogue, giving details of capacity, speed, power required, price, and references to parties using them.

P. H. & F. M. ROOTS.

THE WAVERLY COAL AND COKE CO.

Offer for Sale the

YOUGHIOGHENY COAL

DOUBLE SCREENED,

from their Colliery at Smith's Mills, on the Youghiogheny River, thirty-seven and a half miles southerly of Pittsburgh. This Coal has the preference in Pittsburgh over all other YOUGHIOGHENY COAL for GAS PURPOSES.

The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

Full particulars can be had by addressing

PERKINS & JOB, Agents,
27 South Street, New York.
91 State Street, Boston.

J. H. CAUTIER & CO.,

CORNER OF

GREENE AND ESSEX STREETS,

JERSEY CITY, N. J.

MANUFACTURERS OF

Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and
Fire Sand in Barrels,

ALWAYS ON HAND.

J. H. GAUTIER.
C. E. GREGORY.

393-1y

CHAS. H. MEYER & CO.,

227 Chestnut Street, Philadelphia, Pa.,

IMPORTERS OF

LAVA TIPS AND SCOTCH TIPS.

ALL ORDERS DELIVERED FREE TO NEW YORK.

359-1y

FOR SALE,

200 Tons

CANNEL CHIPS.

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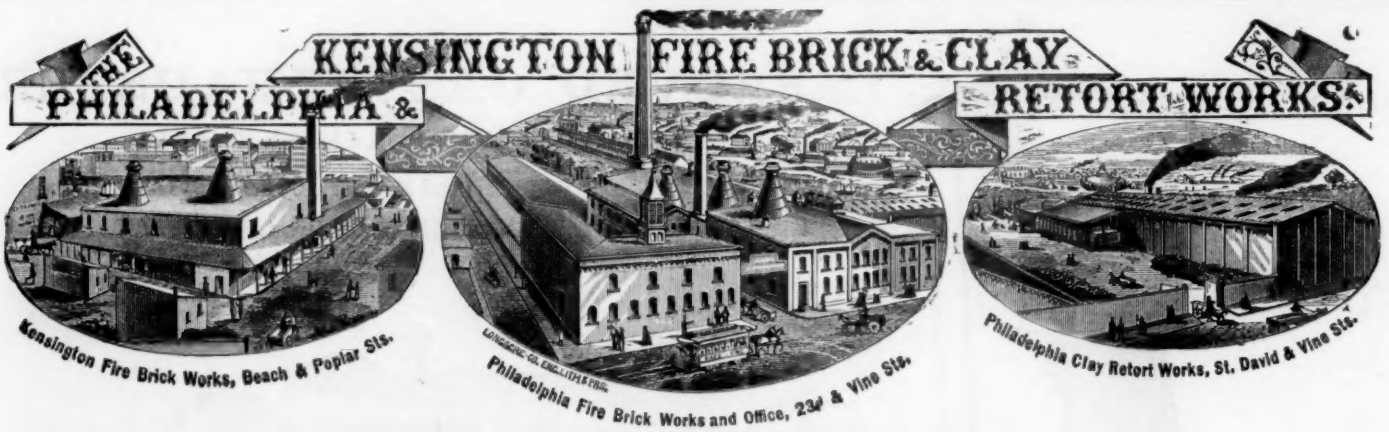
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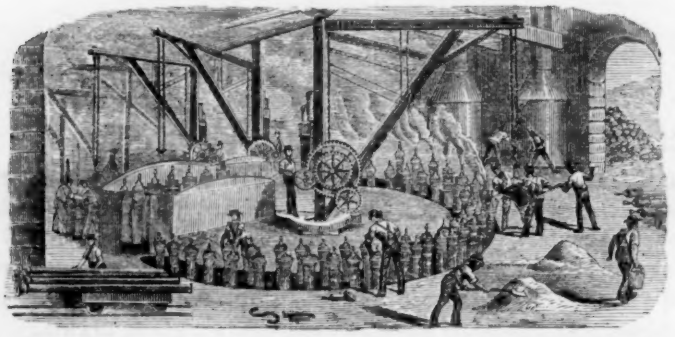

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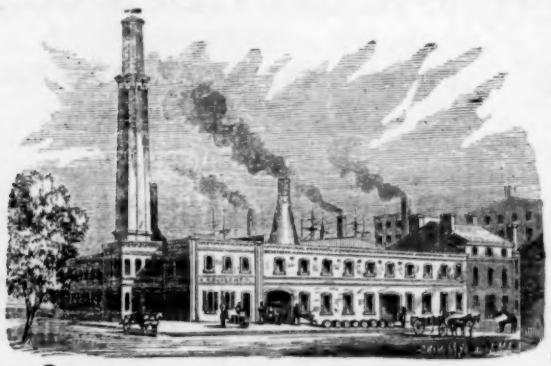

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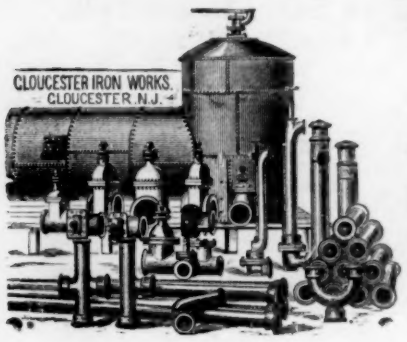

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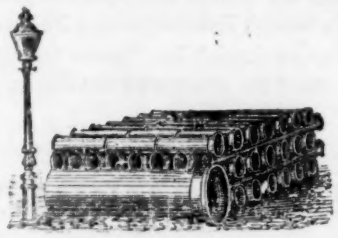

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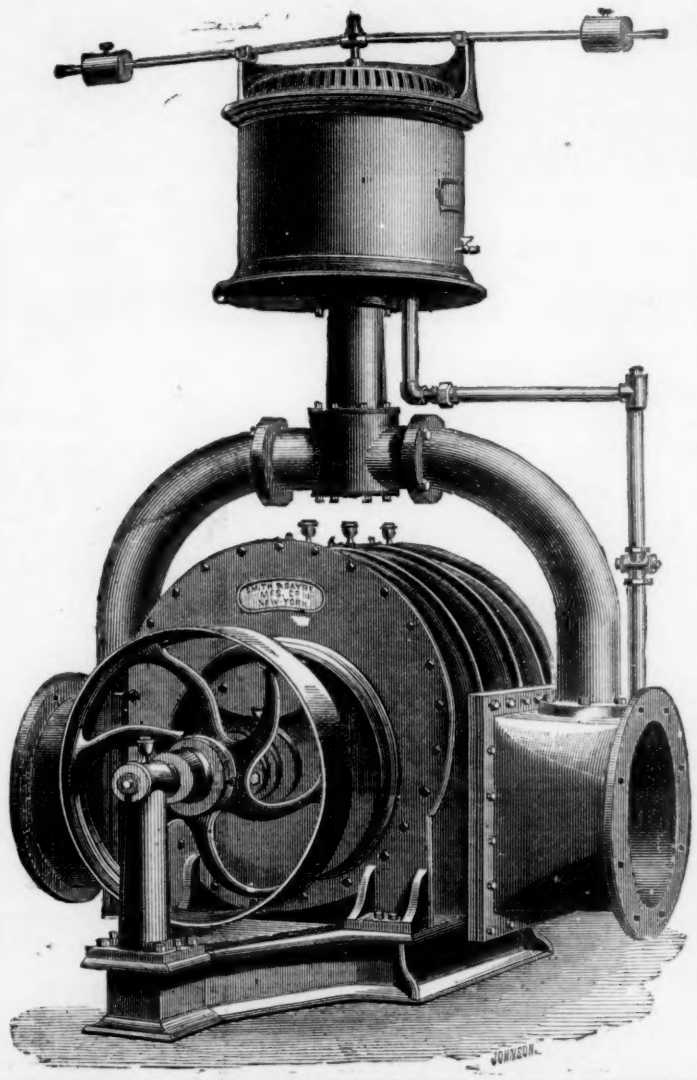

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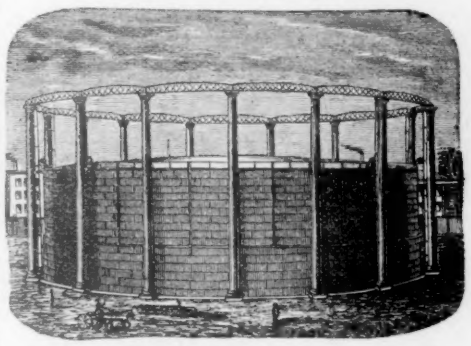

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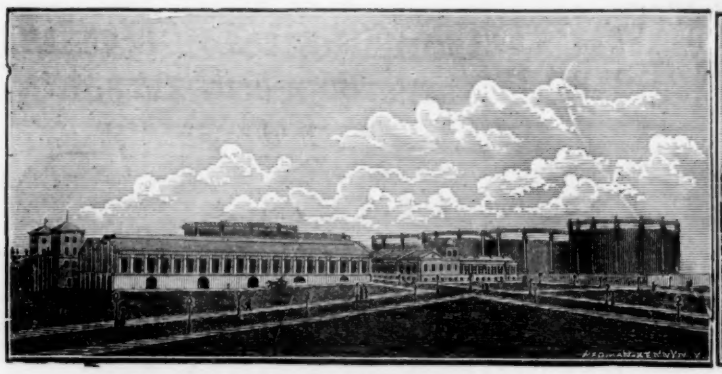

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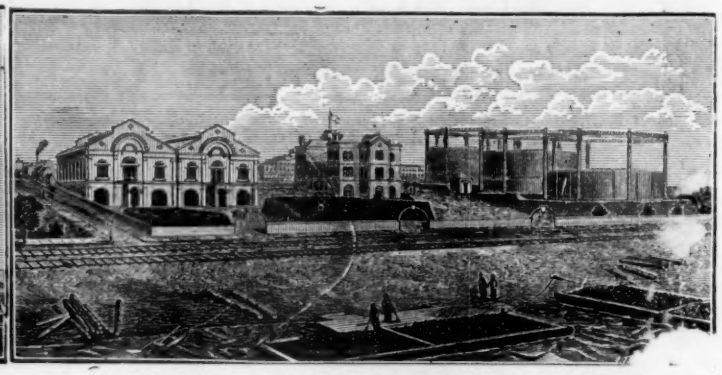

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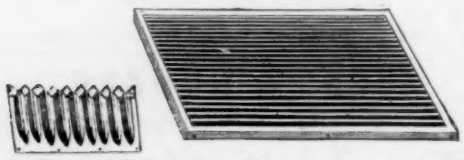

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J. W. GRAHAM,

Dear Sir: Yours of the 14th inst at hand. In reply I would say that we have tested the six anti-freezing Lamp Posts purchased from you, and find them to be all as you represented. Whilst nearly a dozen of our sixty-five Posts were frozen down last month and first of this not one of yours was affected by the heavy frost. What can you sell them at?

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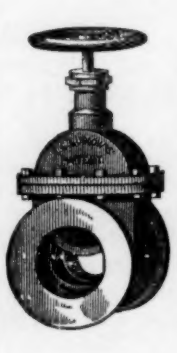

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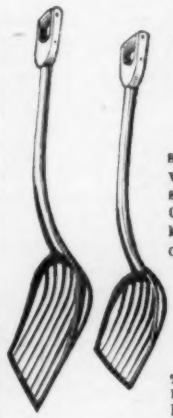

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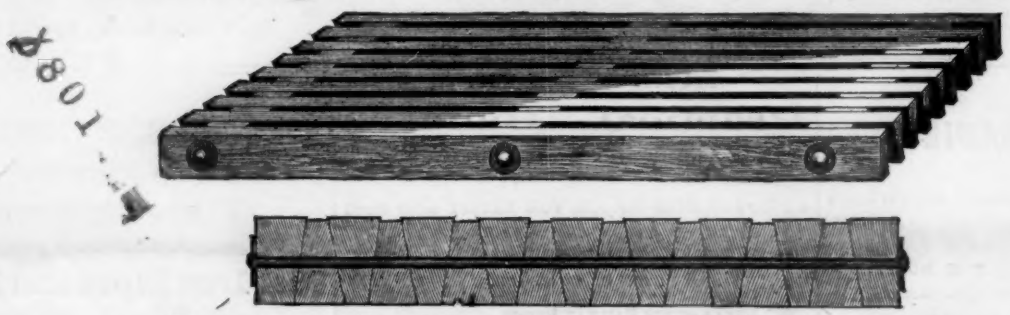

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